

Landscape Review of Interdisciplinary Research in the UK

Report to HEFCE and RCUK by Technopolis and the Science Policy Research Unit (SPRU), University of Sussex

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Anoushka Davé (Technopolis)

Michael Hopkins (SPRU)

Joshua Hutton (SPRU)

Adam Krčál (Technopolis)

Peter Kolarz (Technopolis)

Ben Martin (SPRU)

Kalle Nielsen (Technopolis)

Ismael Rafols (SPRU)

Daniele Rotolo (SPRU)

Paul Simmonds (Technopolis)

Andrew Stirling (SPRU)

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List of abbreviations

| | |
|-------|--|
| A&H | Arts & Humanities |
| AHRC | Arts and Humanities Research Council |
| AHSS | Arts, Humanities and Social Science |
| CDTs | Centres for Doctoral Training |
| DTCs | Doctoral Training Centres |
| ECR | Early Career Researcher |
| EPSRC | Engineering and Physical Sciences Research Council |
| ESCR | Economic and Social Research Council |
| EU | European Union |
| FPE | Full-Person Equivalent |
| FTE | Full-Time Equivalent |
| HEFCE | Higher Education Funding Council for England |
| HE | Higher Education |
| HEI | Higher Education Institution |
| HESA | Higher Education Statistics Agency |
| IDR | Interdisciplinary Research |
| K-W | Kruskal-Wallis |
| MRC | Medical Research Council |
| NERC | Natural Environment Research Council |
| PVC | Pro Vice-Chancellor |
| QR | Quality Related |
| RAE | Research Assessment Exercise |
| RCUK | Research Councils UK |
| REF | Research Excellence Framework |
| STEMM | Science, Technology, Engineering, Mathematics and Medicine |
| STFC | Science and Technology Facilities Council |
| TRL | Technology Readiness Level |
| UoA | Unit of Assessment |
| UK | United Kingdom |
| WoS | Web of Science |

Executive summary

Over the last decade, the desire to address complex societal problems, achieve impact, and create value from working across disciplines has led to an increased emphasis on interdisciplinary research (IDR) among researchers, funders, and higher education institutions (HEIs) in the UK (Nurse, 2015; British Academy, 2016). Simultaneously, there has been concern over the presence (or perception) of barriers against IDR in the UK's research system. Therefore, the objective of this study is to explore the incentives and barriers affecting IDR in the UK. To that end, we engaged three defined stakeholder populations – researchers, funders and strategic leaders at HEIs – across UK regions, disciplines, institution types, and career stages (where applicable) using three methodologies: online surveys, workshops, and in-depth interviews. The combined analysis of our findings forms the basis of this report.

Context for IDR in the UK

While IDR is valued and widely regarded as having an important place in the UK higher education (HE) research system, it is also recognised that IDR has particular needs, which may not be adequately supported in some contexts. Nevertheless, it is also increasingly acknowledged, particularly by strategic leaders at HEIs and funders, that IDR is not an end in itself – but a means to an end such as impact or new knowledge – and that IDR should not be incentivised at the expense of good quality monodisciplinary research. Hence, support should be aimed at removing disincentives and barriers to quality IDR within the research landscape.

Various terms such as interdisciplinary, multidisciplinary, transdisciplinary, and crossdisciplinary are used to describe slightly different ways of conducting research that crosses disciplinary boundaries, creating confusion. These terms are used interchangeably and with varying interpretations in the UK, adding further complexity to undertaking research into this area.

In terms of organising IDR within HEIs, we find that IDR is usually conducted either in dedicated institutes or across discipline-oriented faculties/departments. Funding is obtained through three main mechanisms: institutional block grants from funding bodies such as the Higher Education Funding Council for England (HEFCE), strategic project grants for research on topics specified by funders, and response-mode project grants on topics chosen by the researchers. Block grants and response-mode grants do not have a specific disciplinary or interdisciplinary focus. However, certain strategic funding calls such as those for addressing complex societal problems including global challenges may encourage an interdisciplinary approach.

Incentives

The major incentives for pursuing IDR that emerged from this study are:

- **Pursuit of knowledge** – Many researchers pursue IDR to satisfy intellectual curiosity (i.e. as a way to answer multifaceted research questions) and/or to conduct particularly creative and exciting research. IDR was also seen as an activity that opens up new research fields – or even new disciplines, in some cases – and offers more learning opportunities.

- **Academic quality** – IDR can also be driven by a desire for conducting high-quality, academically rigorous research. A majority of the surveyed researchers find IDR to be academically rigorous in comparison with monodisciplinary research. Stakeholders also valued IDR as a way to challenge existing theories, ask new questions, be more reflective, and combine a variety of methodologies and perspectives. Consequently, IDR has the potential to enrich single disciplines as well as broader research fields.
- **Impact** – An interdisciplinary approach is often beneficial when addressing complex global challenges and research problems of societal relevance. Surveyed stakeholders thought that IDR is more likely to generate societal impact and be cited in journals with broader audiences. Thus, expectations that IDR can lead to impact beyond academia encourages interdisciplinarity.
- **Funding** – The availability of significant new funding opportunities for IDR, such as global challenge-related funding schemes, were cited as a driver of IDR in the interviews and workshops. While only a minority of the survey respondents saw IDR as more likely to be funded than monodisciplinary research, within this minority most respondents saw funders' focus on IDR as extremely or very influential in increasing the likelihood of IDR being funded. Within the same minority, access to larger funding opportunities for IDR was deemed extremely or very influential by most researchers and strategic leaders.

Barriers to interdisciplinary research and some facilitating factors

A number of barriers to IDR were identified across the three research methods. These barriers were perceived to be higher for some stakeholder groups and research areas than others and included the following:

- **Collaboration** – IDR often requires collaborative working with researchers from different disciplines, sectors, or institutions. This presents challenges to establishing shared priorities and a shared language within IDR teams, which in turn are related to the identification of appropriate partners and communication. Researchers in Science and Engineering, and strategic leaders in large HEIs (those with more than 600 full-time equivalent staff submitted to REF 2014) are particularly concerned about these barriers.

The additional demands of IDR such as finding partners and establishing shared goals was identified by many participants as needing more time and resources compared to monodisciplinary research. All three stakeholder groups agreed with this view in the workshops as did the majority of researchers and strategic leaders in the surveys. Funders responding to the survey agreed to a lesser extent that IDR requires more institutional resources.

- **Discipline-oriented cultures** – Disciplinary norms and expectations, as well as discipline-oriented structures such as university departments, can act as barriers against wider engagement between disciplines. Contrasting interpretations of evidence and rigour as well as different methodological requirements can create friction and misunderstanding within teams. Subtle barriers may also exist because interdisciplinary researchers may have a more ambiguous academic identity rather than one 'disciplinary home'.

- **Career-related barriers** – Careers rooted solely in IDR are perceived to be risky (particularly for early career researchers) and as less appreciated by HEIs, thus discouraging researchers from conducting IDR. Peers may view IDR as less rigorous, and interdisciplinary career paths may be less traditional, which may create challenges for IDR researchers trying to build a long-term career. Recruitment and promotion criteria were perceived as more easily evidenced through monodisciplinary research, resulting in a perception that promotion and tenure policies in HEIs discourage IDR. This view is strongest among Social Science and Arts & Humanities researchers, but it is also present to a lesser extent among all other stakeholder subgroups in the surveys.
- **Evaluation of research outcomes** – In the workshops and surveys, all stakeholder groups, except for funders in the survey, concurred that IDR outcomes are likely to take longer to emerge. Publishing IDR was highlighted as more challenging, particularly in what are regarded within disciplines as the ‘top-tier’ academic journals. A majority of strategic leaders, major funders (annual research budget more than £100 million), and researchers in Social Science, Arts & Humanities, and Engineering identify publishing as a challenge in IDR.

Complex views about research evaluation emerged from this study. The majority of survey respondents believed that research evaluation processes could act as a barrier to undertaking IDR. However, through the workshops, effective elements of national research assessment processes were also highlighted. For example, many strategic leaders and researchers in the workshops and interviews were positive about REF impact case studies, which were seen as a showcase for IDR outcomes. Those that had submitted IDR to the REF reported that it was well received. On the other hand, difficulties were reported with placing interdisciplinary departments and IDR outputs within discipline-based units of assessment.

With regard to the REF, uncertainty among researchers and strategic leaders about how IDR would be received in REF 2014 may have resulted in a more conservative approach to research output selection, with single discipline-orientated research outputs favoured for submission over IDR outputs. Thus, departmental and/or institutional practices of HEIs for the selection of research outputs for the REF seem to have reinforced a negative view of research evaluation among interdisciplinary researchers. Better communication of the processes and evidence concerning the treatment of IDR in the REF may help to mitigate the perception among UK researchers that research evaluation in the context of the REF is a barrier against IDR.

- **Funding for IDR** – More than a third of the survey respondents considered IDR less likely to be funded than monodisciplinary research (more than those who considered IDR more likely to be funded). Amongst these respondents, there is strong agreement across stakeholder groups that the monodisciplinary perspectives of reviewers adversely affect the funding of IDR. In addition, finding reviewers with appropriate expertise and knowledge to assess IDR proposals is a major challenge for funders. Most stakeholders also believe that the disciplinary focus of funding opportunities reduces the likelihood of IDR being funded; however, major funders tend not to agree.

During the course of the study some facilitators of IDR also emerged which have the potential to lower the barriers faced by interdisciplinary researchers:

- **Interdisciplinary training** – There was broad agreement that researchers with strong expertise in one discipline along with the capability to collaborate with other disciplines are required for successful IDR. Our findings suggest that training such researchers will require a two-stage ‘dual training’ model wherein researchers first train in a single discipline and then undertake additional training to acquire IDR-related skills.
- **Effective leadership** – Good leaders and ‘interdisciplinary champions’ can be crucial for facilitating and encouraging IDR at different levels starting from individual projects to whole HEIs. Effective leadership can help to develop a research culture that is supportive of IDR as well as create coherence within interdisciplinary teams.
- **Institutional support** – Supporting IDR is a complex activity and HEIs can play an instrumental role in this regard. HEIs can contribute greatly to supporting and sustaining IDR by providing a nurturing research environment and specific support such as seed funding grants, training grants, new infrastructure, and networking opportunities. Strategic leaders from large HEIs report more strongly established support for IDR in their institutions and a wider range of IDR support mechanisms compared to their counterparts in medium/small HEIs.

Policy considerations

On the basis of the findings discussed above, the following points might be considered in order to develop an HE research system that can support IDR effectively:

- Greater clarity regarding the assessment and performance of IDR in the REF could help to remove the uncertainty among researchers and strategic leaders in HEIs about how IDR will be received in the REF.
- The ‘dual training’ model involving first disciplinary training and then additional training for IDR needs further exploration. A discussion is necessary about when additional interdisciplinary training should be offered (at undergraduate, masters, PhD, or post-doctoral level) and in what form.
- IDR requires more time and resources than monodisciplinary research. Funders and HEIs who wish to support IDR need to consider how the additional resource requirements could be fulfilled. Potential strategies include offering pump-priming grants for new IDR projects and spreading the same resource, e.g. a grant, over a longer period to allow time for the team and work to develop.
- Disciplinary perspectives of reviewers might negatively impact the funding, publication, or evaluation of IDR, particularly if IDR proposals or outputs are evaluated in terms of their disciplinary parts. Peer review mechanisms that evaluate IDR proposals or outputs as a whole are required. Funders and publishers need to consider how best to achieve this. This may involve building on the current approach for recruiting individual peer reviewers, review panels and boards, ensuring they are populated with a diversity of expertise including interdisciplinary practice. Panels/boards may need to be supported to recognise where disciplinary approaches may contribute to a variety of reviewer opinions. Researchers also have a role to play as peer reviewers by taking a broader view when reviewing IDR.

- IDR benefits from effective leadership at project, department, and institution levels and hence HEIs should find ways to encourage and build leadership skills among their staff. Leadership, especially at the senior level in HEIs, can help to effect cultural change or establish initiatives that can help to create environments that are open to and support IDR.
- HEIs may need to review and amend their career progression policies to overcome the dominance of disciplinary perspectives, particularly in terms of judging the quality of research outputs and considering the additional time that may be required to produce them. This is particularly significant in light of the existing challenges to publish IDR in what are considered top-tier journals in a discipline. HEIs should reconsider their use of journal impact factors for research areas, where employed as part of recruitment and selection processes, in light of the recommendations of the San Francisco Declaration on Research Assessment.
- HEIs ought to consider how they may create research environments that support IDR. Provision of spaces such as meeting rooms or purpose-built centres, networking opportunities, seed funding, institutional project support, openness to all types of research, and rewarding IDR activity can all contribute to the establishment of a supportive environment.

While most of the stakeholders we spoke to in the interviews and workshops were positive about current developments in IDR in terms of funding and support, we expect that concerted effort from funders, HEIs, and academia will be required to further lower barriers to IDR and create more supportive contexts for IDR in the future.

1 Introduction and Literature Review

The HE sector has gone through important changes in the last decade with structural changes in funding systems, internationalisation leading to increased interactions among researchers, and recent real-term cuts in budgets since the financial crisis (Marginson & Van der Wende, 2007; UK Universities, 2015). Change is also underway in the type of research that funders seek to support: there is greater emphasis on research with commercial application and societal impact (Nurse, 2015), as well as research that provides timely solutions to complex societal problems (e.g., healthy aging, food security, climate change, biodiversity conservation).

Addressing complex societal problems, and indeed some lines of curiosity-driven fundamental enquiry, requires research approaches that build on a diverse set of theories, concepts, tools, data, and methods, often beyond the scope of a single discipline or specialty. For the purpose of this report we refer to this research modality as interdisciplinary research (IDR).

Qualitative and quantitative evidence exists on the positive relationship between IDR and societal impact. Though IDR is not a sufficient nor necessary condition for generating societal impact, it can support it, as IDR can be related to problem-orientation and stakeholder engagement (Molas-Gallart et al., 2014). For example, a majority of the research underpinning societal impact in the impact case studies submitted to the 2014 UK Research Excellence Framework (REF) was multidisciplinary (King's College London & Digital Science, 2015). This research falls within the scope of the definition of IDR employed in this study, suggesting that IDR is often useful for addressing issues of societal relevance.

To capture the potential benefits of IDR and inform an effective IDR policy, a better understanding of the barriers that hinder researchers from undertaking IDR as well as the incentives that encourage them to become involved in IDR is crucial. To gain such an understanding, a comprehensive approach that explicitly considers the complexity of the whole research system and the perceptions and attitudes of all actors within this system is required. This is especially important in the UK where the government-funded dual-support system (competitive funding awarded by research councils for specific projects and unhyphenated funding allocated to HEIs) is complemented by a large variety of charitable and private sector organisations that also fund research (Grassano et al., 2016). Moreover, previous research has mostly focussed on the perspective of researchers, while the perspectives of HEIs and funders have been relatively neglected. Therefore, this study incorporated views from all three stakeholder groups across the UK's research landscape. Our research design and analysis was informed by extant literature on IDR¹.

¹ Relevant studies were identified based on the authors' knowledge and a keywords search of publication titles listed in Web of Science. We specifically used the following terms: *interdisciplinary**, *multidisciplinary**, *crossdisciplinary**, *transdisciplinary**, *nondisciplinary**, *post-normal science*, *second order science*, *post-academic science*, *service science*, *para-academic*, *hypodisciplinary**, *infradisciplinary**, *metadisciplinary**, *supradisciplinary**, *hyperdisciplinary**, *postdisciplinary**, *pluridisciplinary**, *polyscopy*, *undisciplined research*, *team science*.

1.1 Defining IDR

In this study, we use the term ‘IDR’ to refer to all research activities that cross disciplinary boundaries (in contrast to ‘monodisciplinary’ research by which we mean research in a single discipline). These include research activities that are often described as ‘multidisciplinary’, ‘transdisciplinary’, and ‘crossdisciplinary’ as well as interdisciplinary. For consistency and comparability with a previous Higher Education Funding Council for England (HEFCE) and Research Councils UK (RCUK) report on IDR (Elsevier, 2015), we adopted the definitions of ‘multidisciplinary’, ‘interdisciplinary’, ‘transdisciplinary’, and ‘crossdisciplinary’ reported in Table 1. With the exception of ‘crossdisciplinary’, the aforementioned terms have been used to indicate research that crosses the boundary of a single discipline/specialty, but with different levels of integration between the research ‘components’ (Rossini & Porter, 1979). However, there are considerable differences in the understanding of these terms. In contrast, ‘crossdisciplinary’ is often used to refer to the other three modalities of discipline-crossing research.

Table 1 IDR and adopted definitions of multidisciplinary, interdisciplinary, transdisciplinary, and crossdisciplinary research

| IDR | Definition |
|-------------------|---|
| Multidisciplinary | “Theory, methods, and interpretive standards of the different disciplines are employed. Interpretation of the results from different disciplines typically occurs post hoc, often from the perspective of one discipline that may emerge as dominant within the project.” (Rossini & Porter, 1979) |
| Interdisciplinary | “Approaches integrate separate disciplinary data, methods, tools, concepts, and theories in order to create a holistic view or common understanding of a complex issue, question, or problem” (Wagner et al., 2011, p. 16) |
| Transdisciplinary | “Trans-sector, problem-oriented research involving a wider range of stakeholders in society” (Klein, 2008, p. S117) |
| Crossdisciplinary | This term is often used to describe the three research modalities defined above. |

Source: Authors’ elaboration

The lack of broad consensus on ‘what IDR is’ might be explained by the variety of actors that are involved in this debate (Lau & Pasquini, 2013). In addition, the variety of interdisciplinary approaches adopted by researchers further reflect the ambiguous nature of the concept, which responds to various drivers (creativity, technological innovation, societal orientation) and materialises as different types of collaborations (Laudel, 2001).

Considerable differences of opinion about the origin of IDR further complicate the understanding of interdisciplinarity (Klein, 1990). Although the actual term only emerged in the 20th century, for some the basic idea of interdisciplinarity is much older, rooted in the ideas of philosophers such as Plato, Descartes, Kant, Hegel, and others who advocated a universal approach to knowledge (Klein, 1990). For others, it only makes sense to talk about ‘interdisciplinarity’ in the context of disciplines. Up to the early 19th century, there were no academic disciplines. Apart from law, medicine, and theology, all the rest of knowledge was bundled together as ‘philosophy’. By the 19th century, some universities were beginning to separate ‘natural philosophy’ (i.e. science) from ‘moral philosophy’. But it was only later in the 19th century (first in German universities, then spreading to other countries) that natural philosophy began to be split into a number of scientific disciplines (e.g. physics, chemistry, biology, geology), and likewise various social science disciplines began to emerge from moral philosophy. Ultimately, this trend towards increasing specialisation led to segregation between academic sub-cultures over time and gave rise to the modern connotation of ‘disciplinarity’ (Klein, 1990; Becher & Trowler, 2001), which is the basis of current discourse on interdisciplinarity.

1.2 Studying IDR

Despite apparent biases against IDR in disciplinary orthodoxies, the debate on IDR has become more central to research policy and management as seen in recent policy narratives (e.g., US National Academies of Sciences, 2005; Nurse, 2015). Research organisations are increasingly requested to steer their ‘monodisciplinary’ research trajectories towards IDR approaches as well as to provide more training in IDR (Spelt et al., 2009). Research funders and higher education institutions (HEIs) are allocating increasing amounts of money towards stimulating and conducting IDR (Lyall et al, 2011). For instance, new IDR institutes have been established and funding of IDR projects through *ad hoc* designed schemes has become a major focus of research councils (ESRC, 2015; MRC, 2013).

These developments indicate increased policy interest in collaboration practices, often linked to IDR and stakeholder engagement. In the US and UK, in recent years, the relationship between IDR and engagement has been studied by a community around “Science of Team Science” (National Research Council, 2015; Academy of Medical Sciences, 2016).

Numerous efforts have also been made in the development of methodologies and metrics for assessing the extent to which research is interdisciplinary. Qualitative measures of IDR collaborations based on self-assessments by participants have been proposed along with various quantitative approaches based on bibliometrics (Wagner et al., 2011). On the basis of these approaches, studies have provided evidence on the growth of IDR since the 1970s (Gingras & Larivière, 2010; Porter & Rafols, 2009). On the other hand, statistics on how many UK researchers are interdisciplinary are hard to find because a uniform measure for interdisciplinarity has not been applied for researchers across the research system. A previous survey-based study reported that 80% of researchers in the UK conducted at least some IDR, of which only 10% did IDR exclusively (Evaluation Associates, 1999). However, this is a considerably old study and the current situation is unclear.

One issue that quantitative studies have not yet settled is the relationship between IDR and citation impact. Evidence suggests that research with a moderate degree of interdisciplinarity is more likely to have a higher citation impact than research with very high or very low degrees of interdisciplinarity (Yegros-Yegros et al., 2015). Similarly, the highest citation impact in scientific subjects (Science, Technology, Engineering, Mathematics and Medicine [STEMM]) was shown to come from papers that include a small percentage of very highly atypical references (i.e. from journals not often co-cited in literature of the host field) with a substantive number of conventional references (i.e. from similar journals) (Uzzi et al., 2013). However, one study found that IDR articles gain more citations than disciplinary research articles 13 years after publication, while they receive a lower number of citations in the early years (Wang et al., 2015). Other studies have provided evidence of a linear positive relationship between IDR and citations (Chen et al., 2015). Nevertheless, it is important to note that there is considerable disciplinary variation in citation practices and the types of research outputs covered by bibliographic databases (Wilsdon et al., 2015). For example, conference proceedings which are common research outputs in computer science and engineering, and book publications which are important in the social sciences and humanities are under-represented in most bibliographic databases. Thus, there is an inherent limitations in using citation-based methods to determine the degree of interdisciplinarity as well as the impact of an interdisciplinary project.

1.3 Literature on barriers to and incentives for IDR

From reviewing the literature, it is possible to group barriers to and incentives for IDR in four categories related to: (i) **career**, (ii) **funding**, (iii) **collaboration**, and (iv) **research outcomes**.

1.3.1 *Building an interdisciplinary research career*

Researchers might be expected to have considerable intellectual freedom in the topics they choose to pursue, yet they tend to be reluctant to abandon their disciplinary focus even when they recognise the importance of or the potential career benefits associated with undertaking IDR (e.g. Kahn, 2011; Pellmar & Eisenberg, 2000). This may be because IDR may expose them to career and professional risks as a consequence of leaving known disciplinary communities and established innovative research trajectories (Jacobs & Frickel, 2009; Reif & Strauss, 1965; Rhoten & Parker, 2006). The quality of research that is carried out at the interface of two or more disciplines may be perceived as poor by researchers' disciplinary peers since it may not provide the same depth as disciplinary research. Also, involvement in interdisciplinary teams exposes researchers to the risk of losing their professional identities.

These barriers are more likely to affect specific groups in the research community. Some research fields and researchers tend to be more interdisciplinary than others. For example, on the basis of the extent to which scientific articles reference articles in another discipline and vice versa, research areas such as 'social studies of medicine', 'geriatrics & gerontology', and 'general biology' were found to be more interdisciplinary than areas such as 'economics', 'virology' and 'probability and statistics' (Wang et al., 2015). We might expect researchers in these fields to feel less pressured to conform to monodisciplinary orthodoxies, and thus this barrier may not be uniformly observed across academia.

Promotion and tenure policies based on discipline-specific evaluation criteria may also introduce institutional barriers against undertaking IDR. For example, decision making for promotion is often dominated by disciplinary selection criteria and practices that may exclude

valuable perspectives from other disciplines (Scott, 2007; Travis & Collins, 1991). These include priority to contributions in the fields corresponding to departmental structures, preference for journal articles over books in some disciplines, and discipline-biased peer-review processes.

The resources and time required to complete training in one or more disciplines or for midcareer retraining as well as to keep up with these disciplines (e.g. new findings, methodologies, theories) are additional research career-related barriers to IDR (Chubin et al., 1996; Pellmar & Eisenberg, 2000).

1.3.2 Funding IDR

Considerable challenges exist in the design of effective funding mechanisms for IDR as well as the assessment and evaluation of IDR outcomes (Lowe & Phillipson, 2009). In the UK, hypothecated funding is distributed by seven research councils, which are organised around macro areas such as engineering and physical sciences, arts and humanities, and environmental sciences. Consequently, a research project will fall either within or outside an individual research council's scope depending on the disciplines involved. This can be a particular challenge for IDR which may straddle the remits of different research councils. Cross-Research Council funding systems have been established to enable the research councils to collaboratively fund and manage projects, albeit badged as an award from a single research council, that cut across their individual remits. Initial cross-council initiatives (in the 1990s) lacked co-ordination, but since the establishment of RCUK in 2002, systems and cultures have become more harmonised across the research councils (Lowe & Phillipson, 2009).

Internationally, many funding agencies build programmes around themes that lend themselves to interdisciplinary approaches, thus adopting a top-down approach to encourage IDR (Gleed & Marchant, 2016). However, these funders also reflect on grappling with the challenges of establishing effective structures to facilitate IDR and of finding reviewers who know how to evaluate IDR. Some reviewers or review panels may be ill-equipped to assess all parts of interdisciplinary proposals, especially if they involve novel combinations of different perspectives, while proposals with a narrower focus may be easier to explain and match to reviewer expertise. In the case of the Australian Research Council this was reported as a potential cause of lower funding success rates for interdisciplinary proposals (Bromham et al., 2016). In this study, interdisciplinarity had the largest negative impact on funding success in the environmental sciences, physical sciences, economics, mathematical sciences, and history and archeology, and a slight positive impact in agricultural and veterinary sciences, earth sciences, law and legal studies, and built environment and design. It may be that cultural differences among disciplines add to IDR funding problems. For example, in some disciplines reliance on external funding is the norm for research, while in others it is not.

Good design and management of IDR funding schemes can have a positive effect on the success of IDR by encouraging productive collaborations and helping to realise outcomes. This benefits from continuity of expertise over the long-term within funding agencies (Lyall et al., 2013).

1.3.3 Interdisciplinary collaborations

IDR often involves collaborations between researchers belonging to different (even distant) disciplines and sectors (e.g. government departments or companies) leading to potential

communication and coordination barriers (Cummings & Kiesler, 2005 and 2007). A significant amount of time is required to overcome communication problems and cross 'intellectual turf' due to different languages (jargon), methodologies, and practices (Bauer, 1990; Falk-Krzesinski et al., 2010). For example, other disciplines' concepts and methods may be viewed as less important or less rigorous. Practices regarding authorship may also be very different among disciplines and, therefore, it may be difficult to evaluate a team member's performance in another discipline without familiarity with the norms and evaluation criteria of that discipline (Kahn, 2011).

Collaboration barriers are even more influential in transdisciplinary research, where academics and societal stakeholders such as governmental agencies, non-governmental organisations, or industry usually collaborate. Studies of one Dutch and one French university have shown that IDR is strongly correlated with the intensity of university-industry connections (Carayol & Thi, 2005; van Rijnsoever & Hessels, 2011).

Among transdisciplinary collaborations with industry, two barriers can be identified: orientation barriers and transactional barriers (Tartari et al., 2014). Orientation barriers refer to the clash between norms regarding open dissemination and autonomy, and industry norms of disclosure restriction. Transactional barriers refer to the cost in time and effort for the legal formalities of establishing a collaboration between an academic organisation and a company. Factors such as professional experience in industry, previous collaborative experience, and trust among university-industry partners support the success of such mixed collaborations. Similar barriers may affect transdisciplinary research in fields such as sustainability or climate change, where collaborations include not only industry, but also other types of stakeholders such as policy-makers and civil society organisations.

1.3.4 Assessing the quality of IDR outcomes

Although IDR can sometimes give rise to entirely new disciplines, it is often resisted by established disciplines because its outputs may be 'unorthodox' and difficult to assess in terms of quality (Kuhn, 1962; Martin, 2012). Moreover, interdisciplinarity may occur at different levels (e.g. project, topic, programme, theme). Furthermore, outcomes are often integrative and may not fit existing structures (e.g. disciplines, journals), thus making them difficult to evaluate (Strang & McLeish, 2015).

Editorial and peer review processes for assessing IDR outputs for publication, promotion, and research funding allocation tend to be dominated by disciplinary criteria which may exclude valuable interdisciplinary contributions (Scott, 2007; Travis & Collins, 1991). For instance, editors of established disciplinary journals may oppose the publication of interdisciplinary articles because they are not expected to capture the attention of the main readership (Lattuca, 2001). In other words, IDR may be viewed as lower value in the 'top' disciplinary journals.

There is also evidence that certain evaluation mechanisms may disfavour IDR (Langfeldt, 2006). IDR outputs may be viewed less favourably in journal ranking systems, for example in the field of Business and Management in the UK (Rafols et al., 2012). In HE systems 'research excellence' is often rewarded based on disciplinary norms, which, in turn, appears to disadvantage IDR (Laudel & Origgi, 2006). Indeed, a survey from 1999 showed that departments and researchers in the UK's HE sector widely believed that the Research Assessment Exercise (RAE, the precursor to REF) inhibited IDR (Evaluation Associates, 1999). Although there was no evidence of systematic discrimination against IDR in RAE

1996 according to the same study, inconsistent treatment of IDR across individual assessment panels (some were based on single disciplines, others were broader) was noted. Moreover, submissions from departments that had split their researchers across panels or sought cross-referral between panels achieved lower ratings, suggesting that departments that were not organised along the same lines as the RAE panels, e.g. interdisciplinary departments, were disadvantaged. In contrast, the outputs flagged as interdisciplinary in the recent REF 2014 seemed to do equally well compared to those not marked as interdisciplinary (Herbert, 2014). Nonetheless, some biases may exist at the level of submission. For example, a lower proportion of IDR was submitted to REF 2014 than expected. 8.4% of UK publications in Scopus featured in the world's top 10% IDR, but only 6.4% were submitted to the REF (in Scopus; Elsevier, 2015).

2 Approach

We adopted a mixed method approach combining stakeholder workshops and interviews with larger scale national online surveys in order to examine barriers to and incentives for IDR in the UK research system. Each of the methodologies targeted three different stakeholder groups: (1) researchers at HEIs, (2) strategic leaders within HEIs, and (3) programme managers and strategic leaders in research funding organisations (funders). The sample of individuals from each stakeholder group was designed to cover different UK regions, types of HEIs (by size and specialisation), funders, research areas, and career stages (for researchers only).

The underlying rationale behind including a diverse range of perspectives and methods was to develop an in-depth and comprehensive understanding of the IDR landscape in the UK.

2.1 Workshops

In order to develop effective data collection tools for the other methodologies, we undertook scoping activity through three facilitated workshops organised by HEFCE with a representative pool of stakeholders from each group. The strategic leaders' (15 participants) and funders' (9 participants) workshops were roundtable discussions, while the researchers' workshop (21 participants) comprised three separate activities exploring the breadth of experience of the participants. Discussions centred around barriers and drivers for IDR as well as definitions and perceptions of IDR. (See Appendix A.)

2.2 Interviews

In-depth interviews were used to collect qualitative data on barriers to and incentives for IDR from the point of view of each of the stakeholder groups. We interviewed a representative sample of 15 researchers, eight funders, and eight strategic leaders across the strata described above. The interviews were about one hour each and were semi-structured (see interview templates in Appendix D). The semi-structured format enabled us to focus on the core analytical themes and issues of interest, but with the flexibility to probe responses and explore issues that emerged during each interview. Interview findings are described in Appendix B by stakeholder group.

2.3 Surveys

Three separate surveys (see Appendix E) were designed and survey population frames developed to capture the perspectives of each of the three target stakeholder groups. For analysis, these three stakeholder groups were further divided into subgroups. Researchers were assigned to one or more of four research macro areas (Engineering, Science, Social Science, and Arts & Humanities) based on self-declaration of their core discipline. Strategic leaders at HEIs were divided into those based at large HEIs (more than 600 full-time equivalent [FTE] researchers submitted to REF 2014) and those at medium/small HEIs (600 or fewer FTE researchers submitted to REF 2014). Funders were classified as major funders (annual research budgets greater than £100 million) or minor funders (annual research budgets less than £100 million). Detailed survey methods are presented in Appendix C.

We relied on three novel methods for building population frames, as such a study design is unprecedented in the UK context. For the researchers, we used the Web of Science (WoS) – an indexed database of research publications spanning a wide range of disciplines – to identify 105,839 unique email addresses of UK-based corresponding authors from

publications published between 2013 and 2015. We sent the survey to 18% of this population and obtained a response rate of 13% (2,183 responses). While the WoS does cover all disciplines, there are varying levels of coverage with regard to scholarly publications because of differences in the propensity of different disciplines to publish journal articles and coverage within online databases (as opposed to other forms of research output). In the end, the proportions of survey respondents for the four research macro areas were: 52% Science, 8.7% Engineering, 29.8% Social Science, and 9.6% Arts & Humanities. In addition, 83 PhD candidates responded to the researchers' survey. We collected 175 additional responses by deploying a dedicated survey (see Appendix C), bringing the overall number of responses from PhD candidates to 258.

For the HEI strategic leaders' survey, we contacted research management staff and strategic leaders (1,080 individuals) at 15 HEIs representing different UK regions, sizes, and specialisations. The average response rate was 34% (367 responses). Finally, for the funders' survey, we obtained contacts for research managers (118 individuals) in the UK-based Research Councils and funding bodies (23% response rate, 27 responses) as well as funders (844 email addresses, 67 responses) that had posted funding calls in Research Professional – a funding opportunities database. In total 2,819 responses were obtained over all three stakeholder groups.

The non-parametric Kruskal-Wallis (K-W) test was used to test for statistically significant differences between the distributions of responses of different sub-populations. A p-value < 0.05 was considered significant. An ordered logit regression model of the declared importance of IDR against involvement in IDR was used to determine if involvement in IDR affected individuals' likelihood to find IDR important. The same model was used to identify the extent to which responses of Early Career Researchers (ECRs) differed from those of their more senior peers.

2.4 Synthesis of findings

The findings from the surveys were triangulated by theme with those from the workshops and interviews to make a final assessment of the types of incentives and barriers that affect IDR in the UK. We also analysed how these barriers and drivers were perceived in the UK research system by the different stakeholder groups and subgroups in order to understand their nature and impact on IDR.

3 Findings and Analysis

This section presents the key findings from the study, drawing on results from the workshops, interviews, and surveys, and each of the three stakeholder groups. The results are triangulated here to reflect agreement and disagreement in respect to the key findings of the study. Full results are detailed in Appendix A (workshops), B (interviews), and C (surveys). The key findings are presented by theme below, covering in turn the incentives for, barriers to, and facilitators of IDR in the UK HE research system. This thematic analysis is preceded by a discussion of the IDR context in the UK.

3.1 Context for IDR in the UK

The workshops and interviews gave us the opportunity to explore stakeholder perceptions regarding the current context for IDR in the UK. Here, we focus particularly on IDR terminology and ways of funding and organising IDR in HEIs. Stakeholder perceptions of the current and future status of IDR in the UK are also discussed.

3.1.1 *Use of terminology*

There was no consensus about IDR terminology among the stakeholders. Many study participants did not recognise any difference between various terms such as interdisciplinary, multidisciplinary, transdisciplinary, and crossdisciplinary. However, a broad binary distinction was made between large projects where experts from different disciplines each add their own disciplinary expertise (i.e. ‘multidisciplinary’ or occasionally ‘crossdisciplinary’ research), and researchers or projects where two or more disciplines are actually fused creating genuinely new methodologies or approaches, transcending at least to some extent the original ‘home’ disciplines (i.e. ‘interdisciplinary’ or very occasionally ‘transdisciplinary’ research). Nevertheless, terminology remains secondary to practical application – stakeholders’ statements suggest that the interdisciplinary approach best able to address a research question is usually adopted.

3.1.2 *Funding and organising IDR in HEIs*

UK researchers currently access research funding through three main mechanisms: institutional block grants from funding bodies such as HEFCE, strategic project grants for research on topics specified by funders, and responsive-mode project grants on topics chosen by the researchers. These mechanisms are geared to be inclusive towards all types of research including IDR. However, funders may demand an interdisciplinary approach for strategic funding calls that are directed specifically at addressing complex global challenges. Currently, the EU’s Horizon 2020 programme and the UK’s Global Challenges Research Fund provide funding opportunities for those seeking to undertake IDR. In other cases, researchers feel that funding structures and processes are not uniformly effective for funding IDR and vary by funder. The Leverhulme and Wellcome Trusts, which are less reliant on discipline-based review committees (according to funder interviews), were particularly highlighted as being IDR-friendly by researchers, while RCUK funding processes were viewed as being less so.

Interestingly, strategic leaders at HEIs mentioned that a conflicting ‘duality’ may be perceived in the current funding landscape. In their opinion, researchers are faced with, on the one hand, an increasing number of funding streams that encourage interdisciplinarity (e.g. global challenge-related funding streams) and, on the other, with the perception that a single disciplinary identity will lead to better performance in the REF, and thus more quality-related

(QR) funding for their HEI. Whether this ‘duality’ of disciplinary and interdisciplinary pulls creates a problem for IDR is unclear.

Interestingly, an alternative IDR funding model has emerged from this study (strategic leader interviews) and the parallel ‘Case study review of interdisciplinary research in England’ (Technopolis, 2016). This is a ‘funding ladder’ model that enables progressive growth of an IDR field, starting from a small research group to a research centre in three stages. In the first stage, HEIs use internal funds for pump-priming new IDR projects – in some cases QR funding is used for this. These seed funds are typically used for exploratory IDR and team building with the aim of writing proposals for external funding. The second stage consists of acquiring external grants, which are then used to grow the new research area. Where good results emerge and larger amounts of external funding are secured, groups may be elevated to the status of an interdisciplinary centre, which is the third and final stage.

Within the university structure, IDR can be organised in different ways: within dedicated institutes or across faculties/departments based on disciplines. In the funders’ workshop, it was mentioned that constructing physical spaces on campuses for conducting IDR and fostering interaction between disciplines is an emerging practice where new infrastructure often involves the physical co-location of different disciplines under one roof. The Francis Crick Institute is an example of this approach. Similarly, for health-related projects, some universities co-locate research facilities in hospitals to allow better contact between researchers, medics, and patients. However, evidence from the parallel study indicates that co-location is not a pre-requisite of IDR and the effects of co-location can also be achieved for some through virtual networks (Technopolis, 2016).

3.1.3 Perception of current and future IDR in the UK

IDR is valued and widely regarded as having an important place in the UK HE research system, but it is also recognised that it has particular needs which may not be adequately supported in certain specific contexts such as HEIs or departments/faculties within HEIs. At the same time however, the growing interest in IDR and greater funding opportunities for IDR in recent years were acknowledged by many participants across the stakeholder groups. Further moves in this direction were viewed as desirable, particularly for tackling grand challenges and ensuring an innovative research landscape. It was noted that institutional cultures and attitudes are rapidly changing, and that funders and HEIs are becoming more supportive of IDR. Consequently, most of the interviewees were positive about the current status of IDR.

Crucially, it is also acknowledged, particularly by strategic leaders at HEIs and funders, that IDR is not an end in itself – but a means to an end such as societal impact or new knowledge – and that IDR should not be incentivised at the expense of good quality monodisciplinary research. In the interviews, funders commented that support should be aimed at removing disincentives and barriers to IDR within the research landscape.

Nevertheless, some trepidation around structural and cultural issues continues to persist for researchers. It was felt that research funding and evaluation structures and processes, which have originated from academia’s strong orientation around disciplines, may not be able to adequately accommodate IDR. However, it was also suggested that this problem could be mitigated by revising assessment criteria and review structures for IDR funding applications and outputs.

There were also some concerns about maintaining strong disciplines in the face of increasing IDR activity, particularly that some disciplines may be 'left behind' if they are unable to constructively embrace IDR. Some interviewees were worried that risk aversion on the part of funders and HEIs as well as lack of sustained opportunities and funding in the future could potentially undermine further progress in certain IDR fields.

Nevertheless, the stakeholders we interviewed were generally optimistic about the future of IDR in the UK. In particular, researchers were optimistic about further opportunities for publishing and training in IDR as well as support from HEIs. They also anticipated greater funding for IDR in the future as well as greater involvement of researchers in IDR because disciplines as they are currently defined are unable to tackle the complex dynamics of global challenges.

3.2 Incentives for IDR

Stakeholders' views on the incentives that encourage researchers to undertake IDR were explored through the workshops, interviews, and surveys. The main incentives emerging from the combined findings are discussed below:

- **Pursuit of knowledge**

Satisfaction of intellectual curiosity and the pursuit of knowledge is a major driver of research endeavour, and IDR is no different. Certain types of research questions may require an interdisciplinary approach. IDR was identified as a source of particularly creative and 'exciting' research in our study, with the potential to form entirely new disciplines in some cases and offer more learning opportunities. There was strong agreement across all stakeholder groups and subgroups in the surveys that IDR opens up new research fields (at least 79% agreement in each subgroup) and provides more learning opportunities (at least 85% agreement in each subgroup; *Figure 1*).

- **Academic quality**

IDR can also be driven by a desire for conducting high-quality, rigorous research. The surveyed researchers generally agreed that IDR is academically rigorous (ranging from 62% in Engineering to 78% in Arts & Humanities). Stakeholders also value IDR as a way to challenge existing theories, ask new questions, and combine a variety of methodologies and perspectives, thus enriching even single disciplines and increasing their depth. In the researchers' workshop, it was noted that IDR can also offer wider reflectivity and more holistic perspectives resulting in high-quality outcomes.

- **Impact**

Participants in the strategic leaders' workshop agreed that the inclusion of impact case studies in the REF acted as an incentive to conduct IDR aimed at generating research impact. A small number of the strategic leaders and researchers in the interviews, also highlighted this. Furthermore, it was acknowledged that complex global challenges like climate change, food security, and health almost categorically require a degree of interdisciplinary activity and this has led to an increased focus on IDR in all three stakeholder groups in this study. The possibility of making a difference in the world seems to motivate interdisciplinary researchers regardless of discipline.

The majority of survey respondents think that IDR is more likely to generate societal impact (*Figure 1*). IDR was also viewed as more likely to be published in journals that reach broader audiences (at least 49% agreement across all individual stakeholder subgroups). However, fewer survey respondents agreed that IDR outputs are more highly

cited – a view held most strongly (34%) by Engineering researchers and strategic leaders at medium/small HEIs (*Figure 1*).

Figure 1 Perceptions of incentives for IDR based on responses from researchers, strategic leaders in HEIs, and funders. Percentages indicate the proportion of respondents that ‘agreed’ or ‘strongly agreed’ with the statements indicated except for percentages related to funding which show the proportion of respondents considering a factor ‘very influential’ or ‘extremely influential’ in making IDR more likely to be funded than monodisciplinary research



- Funding

A minority of survey respondents thought that IDR was more likely to be funded than monodisciplinary research (ranging from 22% to 28% among researcher subgroups, 30% to 34% among strategic leader subgroups and 8% to 12% among funder subgroups). (See *Figures 12, 26, and 38* in Appendix C.)

In each of the aforementioned minority stakeholder subgroups at least 70% of respondents with the exception of major funders (33%) saw the increasing focus of funders on IDR as extremely or very influential in increasing the likelihood of IDR being funded (*Figure 1*). Similarly, more than 75% of strategic leaders at HEIs and on average 61% of researchers in each subgroup saw access to larger funding opportunities as extremely or very influential in drawing down more IDR funding (*Figure 1*). In contrast, fewer funders counted larger funding opportunities as strongly influential. The availability of larger funding opportunities for IDR, including new global challenge-related funding initiatives, was also cited as a major driver of IDR in the interviews and workshops.

Expectations of higher impact from IDR could also be linked with expectations of greater funding success. This view had broad agreement across the minority of respondents in each subgroup that thought IDR was more likely to be funded.

- **Career opportunities**

In the surveys, only a minority of respondents felt that IDR provides better job opportunities, with funders exhibiting stronger agreement than the researchers (*Figure 1*). In particular, researchers in Social Science and Arts & Humanities were more pessimistic. However, ECRs in Arts & Humanities and PhD candidates in Science (51%) and Social Science (41%) were more optimistic about job prospects offered by IDR, compared to their more established colleagues. Some of the researchers that we interviewed felt that IDR provided an advantage when seeking employment in the private sector. In the workshops, researchers said that working as part of large consortia or interdisciplinary teams was useful for developing networks and skills such as those required for collaborating with businesses, while strategic leaders pointed out that many ECRs consider an interdisciplinary network as an essential tool for building a long-term career.

The above findings show that views regarding what constitutes an incentive vary not only across stakeholder groups, but also by discipline and career stage, and in the case of the main drivers identified above also by type of HEI or funder.

3.3 Barriers against IDR

As observed for the incentives, we found areas of broad agreement as well as strong differences of opinion across and within stakeholder groups with regards to the factors that act as barriers to IDR. Broadly, the barriers were related to the themes of collaboration, discipline-oriented culture, careers, evaluation of research outcomes, and funding. *Figure 2* summarises findings from the online surveys, which are discussed here together with those from the workshops and in-depth interviews.

3.3.1 Collaboration

Since IDR brings together different types of disciplinary expertise, in many cases it involves collaboration beyond the immediate research team, often with partners in different departments, HEIs, or sectors. Consequently, an interdisciplinary team needs to be built and coordinated effectively for a common purpose towards common goals.

The first step towards building a good interdisciplinary team is the identification of appropriate partners, which can be challenging and takes time. Interdisciplinary researchers might be faced with the lack of an immediate community to collaborate with or take inspiration from. Engineering researchers in particular noted difficulties in finding IDR

partners. The majority of strategic leaders (average, 60%) and funders (average, 64%) also concurred that finding the right collaborators is difficult (*Figure 2*).

IDR may involve collaboration with partners outside academia, which can be important to validate IDR and gain different perspectives such as from business, industry, and civil society; however, IDR is no more likely to involve non-HE partners than other types of research (*Figure 1*). In the interviews, stakeholders noted that collaborations between academic and non-HE partners can be very challenging especially when the partners have conflicting norms and expectations. For example, conflicts of interest can emerge between HE and non-HE partners with regard to intellectual property and whether or not to publish certain results.

Participants in the researchers' workshop suggested that within academia, IDR projects are not always truly collaborative and do not always involve equal partnerships. Sometimes researchers continue to work in their own silos only drawing findings together at the end of the project. Furthermore, it is often easier to work with partners within the same faculty than across faculties where cultures and practices can be different. The willingness to collaborate across departments and/or faculties often depends on the signals given by strategic leaders who may not always be open-minded towards collaborative working and IDR. A failure to find solutions for these problems can create tension within interdisciplinary teams and hinder the success of the project.

In an interdisciplinary team, communication is crucial for bridging disciplinary boundaries in order to find common ground, joint priorities, and a shared language, but is difficult to achieve without investment of time and effort. Interestingly, there was a lack of consensus across stakeholder groups as to whether communication was a challenge in IDR. Major funders, Science and Engineering researchers, and strategic leaders at large HEIs were significantly more often concerned about communication challenges in IDR than their counterparts. Interestingly, ECRs in Science were significantly more concerned about this challenge than non-ECRs (Appendix C).

Since communication is key to collaborative research, many interviewees and workshop participants recommended the creation of networking spaces at HEIs that encourage 'water-cooler moments' allowing people from different disciplines to bump into each other and develop contacts as well as conduct 'research conversations'. The benefits of co-locating researchers from different disciplines in a single location such as a research centre emerged as a theme from the interviews and workshops. Notably the proportion of survey respondents that view co-location as important is a minority (*Figure 2*). These conflicting views can perhaps be reconciled in the findings of the parallel case study review of IDR in England, which showed that networking spaces can either be 'physical or virtual' (Technopolis, 2016).

Figure 2 Barriers to IDR as perceived by researchers, strategic leaders in HEIs, and funders. Percentages indicate the proportion of respondents that 'agreed' or 'strongly agreed' with the statements indicated except for percentages related to funding which show the proportion of respondents considering a factor 'very influential' or 'extremely influential' in making IDR more likely to be funded than monodisciplinary research



The view that IDR requires more time and resources than disciplinary research was mentioned repeatedly in the interviews and workshops by all stakeholders. In the survey, the majority of strategic leaders agreed that more institutional resources were required for IDR, but funders agreed to a lesser extent (*Figure 2*). This difference may exist because HEIs are more aware of allocation of institutional resources for IDR within HEIs than funders or because funder respondents thought that the question concerned institutional resources of funders rather than HEIs.

3.3.2 *Discipline-oriented culture*

The traditional system of structuring institutions and departments around disciplines can create challenges in obtaining an active commitment to IDR. Such structures may create disciplinary ‘silos’, consequently creating barriers, which have to be actively lowered for conducting IDR. Some measures that have been adopted to overcome such disciplinary boundaries include building research centres or networks around a strategic theme. However, the research centre model is not always successful as reported in the researchers’ workshop. In the same workshop, traditional research-intensive universities were perceived to be more rigid about retaining discipline-oriented structures than post-1992 universities.

Despite IDR demonstrating significant impacts, a negative perception of IDR still exists in some departments according to a number of workshop participants. It can be difficult for researchers to be ‘taken seriously’ by their subject area if they are too heavily involved in IDR. Such negative attitudes can be made worse if monodisciplinary researchers see IDR as a potential threat to their discipline and/or institutional/departmental vision. There is also a distrust of categorical ambiguity and status; hence, subtle barriers can exist around IDR identities. Sometimes researchers themselves prefer having a defined academic identity, rather than a more ambiguous identity as can be the case for interdisciplinary researchers.

The challenge of understanding and reconciling differing disciplinary norms and jargon presents an additional discipline-related barrier. Contrasting interpretations of evidence and quality as well as different methodological requirements can create friction and misunderstanding within teams. One discipline may view another as less rigorous, creating a hierarchy of more to less robust disciplines. In the researchers’ workshop, participants identified with an embedded disciplinary hierarchy where disciplines like social science are considered less robust than others, while in the funders’ workshop attendees highlighted that a ‘false’ hierarchy can be created between quantitative versus qualitative disciplines or with disciplines seen as performing a ‘service’ function in a project. For example, a significantly larger proportion of researchers from Science and Engineering (20% and 27%) think that IDR requires the involvement of less rigorous disciplines compared to those in Arts & Humanities (10%) or Social Science (14%).

3.3.3 *Career-related barriers*

Interdisciplinary researchers have to face a number of career-related challenges that are, in some cases, different than those of monodisciplinary researchers. Peers in an interdisciplinary researcher’s core discipline may view their work as less rigorous, resulting in a negative impact on their research career. A majority of researchers in Arts & Humanities (52%) and strategic leaders in HEIs (54-57%) supported this scenario, but this view was least prevalent among funders (40-42%) and Science researchers (40%). Such views may create pressures for interdisciplinary researchers to maintain a strong disciplinary research track and conduct interdisciplinary work ‘on the side’.

There is a perception that promotion and tenure policies discourage IDR. Recruitment and promotion criteria at HEIs may be more easily evidenced through traditional disciplinary research, hence IDR may be seen as risky for career progression, especially since IDR career paths can also be less traditional (e.g. if people have come from industry or moved between disciplines). Researchers in Social Science and Arts & Humanities (51% and 50% respectively) are more concerned about the barrier presented by promotion and tenure policies than other stakeholders (*Figure 2*). Interestingly, strategic leaders at HEIs (31%-32%) are much less likely to suggest that career advancement is a challenge for those pursuing IDR than researchers (36%-51%), perhaps hinting at a significant communication gap within organisational hierarchies.

Assessing the pros and cons of an IDR career can be particularly critical for junior researchers and, often, they have to make this choice during their doctoral studies. IDR at PhD level can be perceived as risky particularly within STEMM subjects because IDR can have low citation impact in the short term (Wang et al., 2015), meaning junior interdisciplinary researchers may be less likely to become known in their fields. Furthermore, a recent study suggests some senior researchers discourage their junior colleagues from conducting IDR early in their careers because it is seen as detrimental to a long-term academic career (British Academy, 2016). However, the researchers' survey showed that at least some junior researchers (ECRs in Arts & Humanities; PhD students in Science and Social Science; Appendix C) are more positive regarding job opportunities in IDR than their more senior colleagues. This may reflect a generational shift in attitudes or that the respondents had yet to meet the barriers described by other participants. Similarly, researchers who were interviewed for this study counted IDR as a benefit when pursuing employment in the private sector and participants in the researchers' and strategic leaders' workshops cited an interdisciplinary network and skills as beneficial for building a long-term career.

3.3.4 *Evaluating IDR outcomes*

Because IDR is likely to require more time to develop (see Section 3.3.1), its outcomes are also likely to take longer to emerge. Researchers across the research macro areas and strategic leaders agreed that this is the case, while funders were much less likely to agree that IDR outcomes take longer to produce (*Figure 2*). It may be that those less involved in producing IDR outcomes are less likely to expect these to take longer to produce.

Publishing IDR in top-tier journals was identified as more challenging, although this varied by research macro area. This issue was highlighted as interdependent with concerns about career progression due to the prominence of publications in recruitment, reward, and progression in HE. In disciplines where journals are the main vehicle for publication, the quality of an article is often judged based on the journal in which it is published. The most high-status journals are usually disciplinary and less likely to publish IDR. This view was shared by a majority of the respondents in most of the survey subgroups. Strategic leaders saw this as a problem most frequently as did social scientists but fewer scientists were concerned. PhD candidates in Social Science (40%) and Arts & Humanities (38%) were also less concerned about the difficulties of publishing in top-tier journals than their senior colleagues (Appendix C). Minor funders were also less likely to see this as a challenge than major funders (*Figure 2*).

Compared to the top-tier disciplinary journals, the IDR journals that do exist frequently do not have the same status within academia. Faced with a choice, researchers may opt to publish their IDR in its entirety in 'lower-status' interdisciplinary journals which often have lower citation impact or extract the disciplinary elements of the IDR and publish in the top-tier

disciplinary journals. Alternatively, they may publish the research in a journal special issue or book.

Recently, however, the San Francisco Declaration on Research Assessment has advocated abandoning the use of journal impact factors for evaluating research or recruitment/promotion purposes. This Declaration has been endorsed by many stakeholders, including many UK funders and some universities. If such endorsements do lead to a cultural change in how research quality is judged in the academic community, it could be a positive change for IDR.

Research evaluation per se was not seen as encouraging IDR activity. Researchers in Arts & Humanities and Social Science disagreed more often that research evaluation encouraged IDR (57% and 54% respectively) compared to those in Engineering and Science (35% and 37% respectively). Similarly, 46-47% of strategic leaders also did not believe that research evaluation encourages IDR (Appendix C). There was no clear view from the funders. Many stakeholders also felt that research evaluation undervalues IDR (see *Figure 2*), with funders, especially minor funders (30%), showing the least support.

In the interviews and workshops, discussions regarding research evaluation centred on the REF. In the workshops, and to a certain extent in the interviews and survey comments, researchers and strategic leaders mentioned the inclusion of impact case studies in the REF and signals from their subject subpanel as incentives for conducting IDR. Participants in the strategic leaders' workshop reflected that IDR submissions did equally well in REF 2014 (Herbert, 2014) and that clear messaging and encouragement to HEIs and researchers regarding submitting IDR would help address some of the negative perceptions of REF. The future inclusion of 'IDR champions' in the assessment panels was also suggested as a way to improve the visibility and assessment of IDR in the REF.

In the workshops and interviews, researchers indicated that the unit of assessment (UoA) structure of the REF does not create a clear home for IDR. Several anecdotes of how interdisciplinary departments and researchers struggle to submit to a single UoA resulting in research being fragmented across several UoA submissions were reported in the free text comments to the survey. The lack of clarity in academics' minds about how IDR will be assessed and rewarded in the REF was also raised repeatedly in the study. Researchers and HEIs are unclear about who will be assessing the output, and how experts from different disciplines will rate it; i.e. whether the output will receive positive reviews from all its constituent disciplines. Consequently, institutions may opt for a conservative approach and avoid submitting IDR (a point made in the survey free text comments). Indeed, many interdisciplinary researchers commented that they were excluded from REF 2014 by their institutions. However, in the interviews, researchers who had submitted IDR outputs to the REF said that their outputs were well received. The interviewed strategic leaders also advocated clear encouragement of IDR submissions by REF panels and the publicisation of evidence that IDR does well in the REF as ways to reduce the hesitation to submit IDR outputs to the REF.

3.3.5 *Funding for IDR*

Even though the availability of funding was not cited as a specific barrier by the researchers interviewed, as noted in section 3.2, most survey respondents across the stakeholder groups did not think that IDR was more likely to be funded compared to monodisciplinary research, thus highlighting perceived barriers associated with funding. Researchers in Arts & Humanities and Social Science expected IDR to be funded less frequently than those in

Engineering and Science. A particularly stark result was that funders were three to four times more likely to say that IDR was less rather than more likely to be funded relative to monodisciplinary research (12% versus 35% for minor funders and 8% versus 39% for major funders; Appendix C).

The overwhelming majority of survey respondents who thought that IDR was less likely to be funded thought that this was at least in part because of the monodisciplinary perspective of reviewers. Funders' disciplinary focus was also cited as a barrier by most respondent subgroups (over 69% agreement in most subgroups except for major funders [23%]). Researchers and strategic leaders in the interviews and workshops viewed major funders as influential in reinforcing disciplinary groupings across the broader disciplinary groups: Science, Arts & Humanities, and Social Science. This view seems to have persisted, despite the introduction of interdisciplinary systems such as cross-Research Council funding mechanisms for funding research spanning across council remits. However, some participants cited positive experiences of cross-Council funding mechanisms in the researchers' workshop and identified the barrier as a lack of appropriate referees and review panels. Indeed, the survey highlights the difficulty of finding appropriate reviewers as a very or extremely influential factor for the majority of major funders (62%) who think that IDR is less likely to be funded than monodisciplinary research.

70% of minor funders also suggested that the lack of a specific remit for IDR among funders was a barrier. This might be a particular challenge for funders with limited resources and a very specific focus who may find it difficult to accommodate IDR in their funding policies.

Other reasons that were identified but with a lesser influence include opinions that IDR proposals are viewed as riskier or of lower quality, leading to fewer IDR projects being funded. The perceived riskiness of IDR proposals was more of a concern for researchers in Social Science and Arts & Humanities, and among strategic leaders at HEIs, while funders were less concerned (*Figure 2*). In addition, concerns that IDR bids may be perceived as being of lower quality were notably much higher for strategic leaders at medium/small HEIs compared to large ones (61% versus 34%), while researchers were moderately concerned (*Figure 2*).

In the researchers' workshop, it was noted that while there are more opportunities for IDR funding than before, IDR bids tend to be larger and more complex, making them more difficult to write. However only a minority of survey respondents agreed that producing strong IDR proposals is challenging.

Recruitment of reviewers who mirror the interdisciplinary expertise of the proposal or strong disciplinarians who have some interdisciplinary experience were suggested as ways to improve the review of IDR proposals. Pitches, review panels, and standing panels were also proposed as alternative peer review mechanisms. In particular, peer review panels with a broad range of expertise were consistently cited as being good at assessing IDR.

3.4 Facilitators of IDR

While the main objective of this study was to identify incentives to and barriers against IDR in the UK research landscape, some other factors also emerged that could neither be classified as barriers nor drivers. Instead, they facilitate IDR and may lower barriers. They are described below.

3.4.1 Training of IDR researchers

To be successful interdisciplinary researchers, individuals need to be able to collaborate and communicate effectively with other disciplines. Training can help researchers to acquire these skills. In this study, most participants maintained that a strong disciplinary training of researchers is an essential foundation for IDR (*Figure 2*). Only Social Science researchers were significantly less concerned about such training, while ECRs in Social Science were significantly more concerned about the need of a strong disciplinary training than other researchers in the same field.

While building strong expertise in one field is seen as important by participants, additional training is recommended to enable researchers to become interdisciplinary. We term this the 'dual training' model. There is some variation within and across stakeholder groups about whether considerable time is required for this additional training. The opinions of Social Science versus Science and Engineering researchers and of strategic leaders from medium/small versus large HEIs were significantly different (*Figure 2*). ECRs in Science, Engineering, and Arts & Humanities were significantly more concerned than non-ECRs about the additional training.

Doctoral training has historically been undertaken in the boundaries of disciplines. Some researchers voiced the opinion that PhD students ought to be 'exposed' to other disciplines to understand the limits of their field. According to workshop participants, Doctoral Training Centres (DTCs), Doctoral Training Partnerships, and Centres for Doctoral Training (CDTs) seem to tackle interdisciplinarity quite successfully. Some interdisciplinary PhD projects involve co-supervision from different disciplines which was noted to have an added value in bringing faculty members together for new interdisciplinary collaborations. The recent parallel study of IDR in England makes a similar observation (Technopolis, 2016).

3.4.2 Role of leadership in IDR

Leadership was consistently acknowledged in the workshops and interviews as crucial for creating an IDR-friendly environment in universities and delivering successful interdisciplinary projects. It was noted that leadership is crucial at three different levels. At the institutional level, leaders can convey the institution's commitment to IDR and create structures and mechanisms to support IDR. At the departmental level, the role of leaders is seen particularly in facilitating researcher teams, providing funding, and encouraging people. Senior leadership at the institutional and departmental levels can act as "IDR champions" playing a vital role in changing culture and creating a supportive environment for IDR.

At the project level, leaders act as mentors of junior researchers and lead IDR collaborations. They coordinate research teams to meet research goals, help to build team cohesion, and manage any conflict. Good leaders add value to the research and act as role models. Their personal attributes are equally important. They should be trustworthy, fair, open to different approaches and disciplines, and have a robust attitude.

Able leadership and efficient project management has a major impact on the success of IDR. Due to a higher complexity, IDR projects may require more project management and management support than monodisciplinary research. This is particularly crucial for challenge-led research endeavours where distances between disciplines; involvement of users, non-academic stakeholders, or experts; and international collaborations spread over different locations may add further layers of complexity for project management. This requires leaders who have a vision for the future of the field (and for IDR) and are able to

communicate this effectively to their research teams. Such leadership is not visible enough in the current research landscape.

3.4.3 *Institutional support for IDR*

University structures and policies form a key part of the institutional context for IDR. For example, university research offices can help to bring groups of researchers together. They often provide training courses to researchers and students and help with targeting funding calls and writing proposals for external funding, thus supporting researchers to conduct IDR.

Appropriate structures and policies can help to support and grow IDR activity. The vast majority of strategic leaders and funders (78%-84% and 53%-67% respectively) see supporting IDR as complex (*Figure 2*). Our data show that support for IDR also varies across institutions. Strategic leaders from large HEIs were more likely to see IDR support in their institutions as strongly established (36% versus 14%) or somewhat established (50% versus 43%; Appendix C) compared to medium/small HEIs. Strategic leaders at large HEIs also reported a wider range of support mechanisms such as internal networking opportunities, dedicated centres or institutes for IDR, internal research funding, recruitment of IDR researchers, and IDR training for students.

It was also noted that official university statements are often genuinely positive about IDR; however, when it comes to work organisation, workload management, and funding applications, the particular needs of IDR are not always considered and practical support can be lacking. Although some researchers reported positive experiences of institutional support, others felt that interdisciplinary researchers have to argue their case more effectively at internal performance and promotion panels. A recent study has argued that institutions should follow a clearly articulated commitment to IDR (British Academy, 2016) with practical support for researchers in the form of training, networking opportunities, and career development.

4 Conclusions and Policy Considerations

While this study has identified incentives for and barriers against IDR in the UK research system, it is important to note that in most cases their effects can be perceived more strongly or weakly depending on the context and stakeholder group involved. We observed a wide variation in perception of these effects not only between stakeholder groups, but also within those groups, such as between disciplinary macro areas, large and medium/small HEIs, and major and minor funders. This was evident also in the interviews and workshops where individual experience additionally affected perceptions regarding barriers and incentives.

4.1 Limitations of the study

Despite the advantages of the mixed methods approach used in this study, some limitations are inherent. Firstly, the definitions of IDR are difficult to operationalise due to interpretive issues (see Section 3.1.1) as well as measurement challenges. For example, although past estimates suggest that four fifths of UK researchers self-report engagement in IDR to some extent (Evaluation Associates, 1999), benchmark figures for the number of UK-based researchers that are engaged in IDR do not exist for the present day. Moreover, interviews, workshops, and surveys on the topic of IDR inevitably attract more interest from interdisciplinary researchers and cannot be used to estimate amounts of IDR versus monodisciplinary activity.

Although the survey strategy was designed to gather responses from researchers undertaking IDR and monodisciplinary research, the overall response rate was 13%, leaving room for concerns of response bias. Indeed, relatively few respondents indicated that they had not undertaken IDR at some stage in their careers (ranging from 12% of researchers in Engineering to 5% of respondents in the Arts & Humanities). This may reflect low levels of UK researchers who do not regard themselves as interdisciplinary in some way, response bias, or both. We therefore do not report the views of monodisciplinary researchers, and may not have identified barriers that have kept some monodisciplinary researchers out of IDR altogether. Response rates were much higher for strategic leaders and the major funders (34% and 23% respectively), and as these individuals are more likely to support both monodisciplinary and interdisciplinary research, their views can perhaps be regarded as less coloured by the needs of one form of research or the other (although response bias remains a possibility).

4.2 Lowering the barriers to IDR

This study shows that barriers to IDR certainly do exist in the UK at present, and even though they may be context-dependent, some are broadly experienced. Concerted effort from funders, HEIs, and academia will be required to lower barriers and create more supportive contexts for IDR. In the interviews and to a lesser extent in the workshops, strategic leaders and funders respectively advocated structures that are able to accommodate IDR and mechanisms that remove disincentives. This view stems from the concern that explicit isolated incentivisation of IDR may lead to ‘opportunistic’ or ‘forced’ collaborations at the expense of high-quality monodisciplinary research. While ‘forced’ collaboration was seen as counterproductive in the researchers’ workshop, researchers’ views on IDR-specific incentives were not determined.

It appears that a considered and continuous dialogue is required between the researchers and strategic leaders at HEIs and funders to carry forward structural and cultural initiatives

to support IDR. Crucially, the workshops showed that each of the three stakeholder groups tend to look more often to their peer group to validate their opinions and approaches, thus perpetuating certain narratives within these communities. More cross-group debates and exchange of evidence could be helpful in challenging assumptions and preconceptions.

The remaining sections set out the key findings of the study and associated policy considerations. Issues are discussed in sections according to the stakeholder group that these are most associated with, although these may be of relevance across stakeholder groups.

4.3 Policy considerations for funders

- *Evaluating IDR proposals and outputs*

Since many peer reviewers are experts in one discipline and IDR draws on multiple disciplines, alternative methods to assess IDR proposals and outputs may be necessary especially for awarding grants and research evaluation. IDR proposals and outputs need to be evaluated as a whole rather than as their disciplinary parts, as IDR is often more than the sum of its parts. Funders need to consider how best this can be achieved by building on current processes which seek to recruit and train effective panels with diverse experience. Developing interdisciplinary review panels consistently with broad expertise (including users of research as well as academics) and coaching for referees could be possible ways to achieve fair and robust peer review (British Academy, 2016).

Finding people with the relevant expertise to peer review IDR is also difficult according to our findings. Indeed, the most important consideration for IDR peer review will be the recruitment of the most appropriate individual reviewers or review panels. Views on what this means varied between participants with some expressing a preference for ensuring all disciplines within the research being assessed were represented whilst others noted that experts in the IDR process would add value. Suggested remedies to expand the potential reviewer pool included automated choice (using software) of appropriate peer reviewers based on their REF submissions so as to pick reviewers whose research is closest to the project in question and greater use of international experts.

The disciplinary focus of competitive funding was a concern for many survey respondents across the stakeholder groups. In the workshops, researchers, and strategic leaders specifically highlighted experiences of IDR proposals ‘falling through the cracks’ at disciplinary boundaries even when cross-Research Council mechanisms are used (Research Councils UK, no date). There was a view among funders that reviewers may opt for a conservative approach viewing projects perceived as lower risk more favourably, which may disadvantage IDR projects which can be perceived as higher risk. It is unclear whether either of these problems are substantive or perceived, but they warrant further consideration, since they have also been highlighted by previous studies (Travis and Collins, 1991).

- *REF*

The REF was raised extensively by study participants as an important issue. Although impact case studies and encouraging signals from REF subpanels regarding IDR submission were identified as contributing positively to the assessment and acceptance of IDR more widely, survey respondents in particular perceived IDR as undervalued in research evaluation. More clarity around how IDR is assessed in the REF by panels and

subpanels (including cross-referral practices), as well as its relative performance, may address this issue. Although guidance was available from the UK funding bodies in relation to the submission and assessment of IDR for REF 2014, HEIs and researchers mentioned feeling uncertain about how IDR would be treated by REF panels in practice. This uncertainty has been reported by participants as discouraging some HEIs from selecting IDR outputs. Some researchers mentioned how publications in 'journals with broader audiences' were deselected for submission by their departments. While it is unclear whether this is true across all HEIs, institutions might need to review how their departments choose outputs to submit to the REF and whether their IDR is being adequately represented.

Despite evidence that research flagged as interdisciplinary fared equally well compared to other research in the REF, concerns about how IDR fares in the REF remain. It is important to note that concerns about the assessment of IDR in general appear to vary by discipline with Social Science and Arts & Humanities researchers highlighting this as a particular issue. A better understanding as to whether researchers' concerns are justified needs to be developed. We suggest that in light of Lord Stern's recently published Review of the REF (Stern, 2016) these issues are considered in preparation for a future assessment exercise.

4.4 Policy considerations for academia

- *Training of future interdisciplinary researchers*

While interdisciplinary masters courses and PhD projects are available in the UK (Technopolis, 2016), the consensus emerging from this study is that interdisciplinary researchers should have a firm grounding in one discipline before undertaking IDR. However, the need for additional skills that allow researchers to discuss and understand other disciplinary perspectives and methodologies was also noted as being important. Thus, the 'dual training' model involving first disciplinary training and then additional training for IDR emerged. The academic community needs to determine, area by area, what interdisciplinary training provision is needed and at what level (undergraduate, masters, PhD, or post-doctoral) to ensure appropriate 'dual training' is available to researchers.

- *Research culture*

Academic disciplines provide disciplinary training and undertake research based on the established norms of their tradition. These disciplines also have a major role to play in developing a research culture that is open to and values IDR. Academic communities establish and perpetuate their own norms and values. Naturally, strategic leaders at HEIs, review panel members, and journal editors bring with them ideas and opinions formed by their experience in their own research communities. Disciplines therefore have a strong influence on the extent to which disciplinary siloism and protectionism operate. Individual disciplines, and academia more broadly, contribute greatly to research culture and have the potential to change it. In particular, academics can do a great deal to remove negative attitudes towards IDR and to improve peer review of IDR by adopting a broader view as reviewers.

4.5 Policy considerations for strategic leaders at HEIs

- *Career progression and reward systems for interdisciplinary researchers*

IDR is commonly perceived as a risk to career progression because recruitment and promotion policies are seen to favour disciplinary researchers. IDR might take longer to produce outcomes and may be difficult to publish in what are regarded as top journals. Moreover, researchers might have moved between sectors or disciplines. Institutional recruitment and promotion policies need to accommodate these aspects and reward interdisciplinarity to the same extent as monodisciplinarity to ensure they support researchers engaging in IDR.

- *Creation of research environments supportive to IDR*

Research structures and cultures that encourage and support IDR can facilitate IDR as well as motivate researchers to engage in IDR. A clearly articulated commitment to IDR and supportive actions provide signals that IDR is accepted and valued in an institution. Such actions are helpful in overcoming conformist or conservative pressures that disciplinary structures generate, thus encouraging researchers to become interdisciplinary if they wish to. Provision of spaces such as meeting rooms or purpose-built centres, networking opportunities, funding, institutional project support, openness to all types of research, and rewarding IDR activity can all contribute to the establishment of a supportive environment.

- *Effective leadership*

Good leadership at project, departmental, and institutional levels was noted to be key to successful IDR. Hence, HEIs should try to build and encourage leadership skills in their staff. In particular, senior leaders can trigger change in institutional structures and culture, and can act as role models for junior staff. For instance, they could introduce support initiatives for IDR, take the lead on combatting disciplinary tribalism in departments, or even dissuade risk aversion in terms of submitting IDR outputs towards research evaluation.

- *Resourcing the extra time and resource required for interdisciplinary collaborations*

Undertaking IDR has been identified as requiring more time and in some cases additional resource (Section 1) and this has also been the view of most participants in this study. However, funders who participated in the survey agreed to a lesser extent. Providing the required additional resource so that IDR is not disadvantaged relative to monodisciplinary research requires more thought on the part of HEIs and funders. Some HEIs use core internal funds for pump-priming new interdisciplinary activity and covering the initial costs of building teams and developing proposals for IDR projects (findings from the strategic leaders' workshop; Technopolis, 2016). Spreading the same resource such as grant funds over a longer period was also suggested as a potential strategy in the funders' workshop and another recent study (Gleed and Marchant, 2016).

4.6 Conclusion

To conclude, this study has identified a number of incentives for and barriers against IDR in the UK research system. Lowering the barriers might require modification of both research-related structures and cultures as structures for research influence academic culture and vice versa. It is important to note that there are many examples of how support mechanisms for IDR can overcome some of the barriers highlighted in this study (Technopolis, 2016). An important and ongoing task, however, is to maintain a climate that accommodates IDR in a

landscape where there can be pressures to conform to disciplinary norms and cultures. This will require constant efforts to balance incentives for undertaking monodisciplinary and interdisciplinary research. The challenges in existing systems can be deeply entrenched and seeking to address them will provide new opportunities.

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Appendix A Interdisciplinary Research Stakeholder Workshops Report

A.1 Purpose

The purpose of the 'Landscape Review of Interdisciplinary Research in the UK' is to explore which drivers and barriers for IDR exist in the UK research landscape through engaging three defined stakeholder populations – researchers, funders and strategic leaders at HEIs – using online surveys and in-depth interviews. In order to develop effective data collection tools, we undertook scoping activity through three HEFCE-organised workshops with a representative pool of stakeholders invited to attend from each group.

For the purpose of the workshops, the term 'interdisciplinary research' was used as an umbrella term for interdisciplinarity, multidisciplinary, cross-disciplinary and transdisciplinarity and included:

- Research involving a minimum of two disciplines with the distance between those disciplines unspecified
- Clear additionality – the research is more than a sum of its parts
- Single researchers or a research team that bring together methods, insights and understandings of more than a single discipline

A.2 Summary

Across the three workshops, we saw broad consensus on the following points:

- The impact agenda, global challenges and current funding opportunities (nationally and internationally) are key drivers for IDR within higher education.
- More time is needed for IDR in order to develop a common language, build teams, and develop collaborations which are seen as more challenging in an IDR environment. How to build in resources for this extra time was a central point across the discussions.
- Collaboration is key in IDR. Therefore, opportunities to meet researchers from other disciplines and good project leadership are crucial for the success of IDR. In addition, institutional structures and culture need to be supportive towards IDR and collaboration.
- Evaluating outputs and finding the right peer reviewers can be challenging in IDR.

However, there was a lack of consensus on the following points:

- The REF was seen as a barrier to IDR by some because of the disciplinary nature of the UoAs while others felt that the inclusion of impact case studies in the REF acted to legitimise and promote IDR activity.
- Depending on the discipline, publishing IDR was seen as a barrier or an opportunity.

A.3 Researchers' workshop: 1st March 2016, Manchester

A.3.1 Workshop structure and participants

The workshop was chaired by an academic expert in IDR and actively facilitated. Twenty-one participants undertook three established activities exploring the breadth of experience in the room through a 'world café', narrowing down to themes by cluster walling those experiences, and then making a pitch for the theme most important to them.

Researchers from across the UK and from different university types, career stages, and disciplines were invited to attend the workshop.

A.3.2 World café

The World Café exercise asked participants to consider a series of questions and discuss them in groups for 15 minutes recording their thoughts on paper tablecloths. Each group had the opportunity to consider three of the following questions:

Table 1: How does interdisciplinary research fit into a research career?

Table 2: What can interdisciplinary research offer that monodisciplinary research may not?

Table 3: How do university structures and policies influence interdisciplinary work and research in your university?

Table 4: What are the disciplinary challenges of IDR?

Table 5: Where and how do you access funding for IDR?

Table 6: How can the quality of IDR be assessed?

The responses of participants are summarised below under each question. They represent the micro level of experience, which formed the basis for generating key themes in the clustering and pitching phases of the workshop.

What can interdisciplinary research offer that monodisciplinary research may not?

The attendees tried to identify ways that IDR practice 'adds value' from the perspective of the individual and the research.

The individual

- Opportunity to learn a new 'language'
- Makes it easier to publish papers (in biomedical engineering)
- Can meet different people (networking)
- Fulfils genuine intellectual curiosity
- More interesting than disciplinary research
- Access to journals with higher impact factor for researchers in some areas e.g. anthropology

The research

- Enables one to identify the right tools for the job — access to key expertise (snowball approach)
- Challenges existing research
- Possibility of more funding
- Allows reflectivity – the opportunity to reflect on the context of the research rather than the experiments and results
- Is more democratic (accommodates different voices and perspectives)
- Offers a value system that bridges ideologies
- Can help translate research to impact

What are the disciplinary challenges of IDR?

Participants reflected on the challenges disciplines face, create, and perceive when engaging or considering becoming involved in IDR. The structure of schools and departments, the value of IDR for researchers, what makes a good IDR researcher, communication, and receptiveness to IDR of different disciplines emerged as key themes within the discussion.

Structure of schools and departments

The attendees identified that the traditional structures of Schools and Departments, which are often built around disciplines, created challenges in obtaining an active commitment to IDR. These structures were seen as supporting silos, which keep academics looking inward.

Value of IDR for researchers

The group concluded that researchers feel that they need to get a similar level of benefit or new knowledge from other disciplines. There needs to be an understanding of what a different area can do for a researcher and what researchers can do for the areas. The group emphasised that IDR may not produce the same disciplinary results for each subject area.

According to some participants, once researchers do IDR, they do not go back despite perceived and actual barriers.

What makes a good IDR researcher?

There was a debate about whether academics need to be good disciplinarians to bring about good IDR or whether expertise in analytical methods was enough. It was acknowledged that IDR needs more 'generalists', but that getting/training people who can move between disciplines is difficult.

Three broad types of interdisciplinary researcher were identified:

- Disciplinary researchers who bring their disciplinary knowledge to a project but keep to that knowledge only
- Knitting researchers who work their knowledge in with other disciplines
- Unencumbered researchers who do not view any boundaries and will work on new methodologies

Communication

The group identified finding common ground, joint priorities, and a shared language as areas of difficulty in the current disciplinary environment, making collaboration difficult. Full engagement between disciplines was seen as variable and discipline-dependent.

Receptiveness to IDR in different disciplines

Participants reflected that IDR activity can be seen within some disciplines as less rigorous. Despite IDR demonstrating significant impacts, a negative perception of IDR exists. It can be difficult for researchers to be 'taken seriously' by their subject area if they are too heavily involved in IDR. This can affect future career prospects and is often discouraged in early career stages. It was perceived that multi/interdisciplinary individuals are not seen as employable by departments in comparison to those with a single subject focus.

The group felt that some disciplines are more receptive than others to IDR. Mathematics and engineering were seen as receptive disciplines whilst experiences in medicine and biosciences were reported to be less positive. The participants identified with an embedded disciplinary hierarchy where disciplines like social sciences are considered less robust than others.

How do university structures and policies influence interdisciplinary work and research in your university?

University structures and policies are a key part of the environment in which research takes place. Participants were asked to consider how their own university's structure and policies impact on IDR. Organisational structure, university type, physical structure, volume, and strategic support emerged as key themes within the discussion.

Organisational structure

The group recognised that within the structure of the university, IDR can be organised in different ways: in dedicated institutes or in faculties based on disciplines. It was noted that it is less common to see IDR between faculties. The group's experience was that the nature of the discipline also appears to have an impact. At one university 'research institutes' were introduced to avoid disciplinary silos, but eventually monodisciplinary schools were recognised as a better way to achieve IDR within that institution.

Impact of university 'type'

Several participants raised that post-1992 universities had different conditions for developing IDR from traditional research-intensive universities. Research universities were seen as more attached to disciplinary structures whereas post-1992 universities appeared more open-minded. Universities with smaller research departments were seen to have the scope to situate different research departments next to each other making it easier to break down disciplinary barriers. In contrast, some researchers mentioned that individuals tended to want to keep their research funding to themselves in institutions with limited resources for research.

Physical structure

Physical space was noted to be important for intellectual interaction, meeting people, and discussing problems. 'Serendipity' was a keyword for participants during discussions. Manchester Institute of Biotechnology (formerly Manchester Interdisciplinary Biocentre) and

the Crick Institute were identified as examples of such physical structures. Some participants described how common rooms and meeting spaces are now less common at universities. However, it was felt that space was less critical for IDR than the behaviour and motivation of academics.

Critical mass

Participants reflected that successful IDR requires a critical mass of people and investment. Researchers need to find a group of like-minded people and willing collaborators. It was felt that IDR requires a particular type of personality.

Strategic support

Official university statements are often genuinely positive about IDR, but participants reported that when it comes to work organisation, workload management, and funding applications, IDR is not always considered. Strategically, policy, people, and environment are all important for good IDR and should be supported.

Where and how do you access funding for IDR?

IDR is often highlighted by researchers as an area where securing funding from both external funders and internal university sources can be difficult. The group were asked to consider their own experiences of seeking funding for IDR. The funding landscape, creating funding proposals and collaboration, professional support, funding balance, and the cost of IDR emerged as key themes in the discussion.

Funding landscape

Among funders, RCUK structures were seen to reinforce existing disciplinary silos especially across the broader disciplinary groups: science and arts, humanities, and social sciences. However, some researchers also shared positive experiences of cross-council funding and cited the barrier as a dearth of appropriate referees and review panels.

Researchers' also commented on their experiences of the Leverhulme Trust and Wellcome Trust IDR funding processes which were largely positive. Additionally, EU funding was perceived as very open to IDR and all disciplinary combinations. Their Grand Challenges approach was identified as receptive and accessible to IDR but previous attempts to create forced collaborations was also highlighted as problematic and a risk to good research outcomes.

Creating funding proposals and collaboration

It was acknowledged that while there are more opportunities for IDR funding than before, IDR bids tend to be larger and more complex, making them more difficult to write. Furthermore, although all research when pitched needs to take account of funder requirements, it was felt that this was more challenging in an IDR context especially when approaching funders with disciplinary interests. The combination of science and social science was noted to be especially challenging. The participants acknowledged that successful examples of funding in this space exist, but did not elaborate on specific cases.

It was raised by the group that IDR applications are not always truly collaborative in the 'real' sense of IDR, with researchers continuing to work in silos, and drawing findings together only at the end of the work. This can result in disparity of esteem and a service relationship

between the disciplines. In these cases, the disciplinary perspective of the 'smaller' disciplines can be lost and their contribution may not be adequately recognised.

Researchers advocated a strategic approach to acquiring funding e.g. by mixing available internal funding. The long lead-in times necessary to create collaborations outside of individual disciplines, without the time and support to do so, in advance of formal funding applications was raised by participants as a real challenge to developing effective, fundable proposals.

Professional support

Business development managers with the right expertise were identified as a helpful resource in targeting IDR calls, acting in a facilitating role, and bringing initial groups of researchers together. Alternatively, individuals or projects within institutions can act as gatekeepers for access to funding for IDR in the form of internal pots, or in some cases, external awards.

Funding balance

Unfortunately, tensions can develop in interdisciplinary teams if one or more partners dominate the relationship. It was reflected by the participants that imbalance can be related to perceived funding disparities in projects. For example, in urban sustainability projects, engineering and physical sciences often attract a larger proportion of the grant funding than other disciplines. Participants commented on their perception of an inequality in research relationships between institutions dependent on available financial resource, which mirrored their experience in the disciplines.

The cost of IDR

The group felt that more funding for IDR as opposed to monodisciplinary research was required because it incurs more costs e.g. for building shared enterprise, shared language, and trust as well as resources like time. Resources for building interdisciplinary partnerships and developing proposals can be difficult to find. Participants suggested that funders could invest in more interdisciplinary conferences and sandpits to facilitate interdisciplinary team building. Continued support for existing partnerships is also important.

How does interdisciplinary research fit into a research career?

Developing a culture of interdisciplinarity is partly dependent on how IDR integrates into the academic career. Participants considered, based on their experiences, the different phases of academic training in their discussions.

IDR academic career challenges

Participants raised a number of challenges that they identified to delivering IDR throughout an academic's career:

- Finding the right collaborator and engaging with key contacts and networks, which might be wider than the UK
- Modifying research to fit existing structures to be able to submit to REF and get funding
- Supervisors who may not be open minded towards collaborative working – IDR culture needs to be developed by senior leadership

- Managing income- and research-related expectations. For example, a mathematician working in an engineering faculty might be expected to bring in a certain amount of income for career progression, whereas a mathematician in a maths department may not.
- Disciplinary isolation. For example, one social science interdisciplinary researcher in a facility set up for scientists is automatically disadvantaged.
- Career progression and professional development that is very closely linked to publishing in journals attached to a specific discipline
- Lack of an immediate community to collaborate with and look up to
- Audiences and peers may be difficult to find

Doctoral training

Doctoral training has historically been undertaken in the boundaries of disciplines. The doctoral training centre model was highlighted by participants as an alternative way of delivering doctoral provision which could effectively train the next generation of IDR researchers. They also raised the assumption within universities that studying for a PhD leads to an academic career but this is increasingly not the case – particularly in engineering and other science subjects where interdisciplinary working is key to industrial practice.

Early career choices

It was noted that ECRs have to be very strategic in their career choices for development, and a career in IDR may be perceived as too risky. The group felt that recruitment criteria at universities are more easily evidenced through traditional disciplinary work. Publication of IDR was also highlighted as a challenge for ECRs; it was felt that for someone in their early career, achieving a high-quality publication from a small team based in a highly specialist project would be easier than meeting the needs of a large disciplinarily diverse team.

Participants also highlighted that compared to the top disciplinary journals, the IDR journals that do exist do not have the same status within academia. High status publications were identified as particularly important for young academics trying to build a career. However, it was noted that academics should be able to publish in good disciplinary journals if their IDR is good quality.

IDR can also offer opportunities to work as part of consortia and large interdisciplinary teams. This can be useful for developing networks and skills. One researcher cited the example of a successful consortium which allowed ECRs to publish work as first authors and gain lecturership positions, in addition to gaining knowledge from working with business.

Quality and quantity

The group reflected that IDR takes longer to develop and therefore results in fewer papers compared to work within established disciplines in a set timeframe. Although the REF is designed to assess quality not quantity, universities appear to demand *both*. In many cases it was noted that young researchers do not get the time to develop their work; they are expected to be at the top from the start. Consequently, they have an incentive to take the tried and tested route rather than IDR.

Motivation

Academics doing IDR are often driven by problems and challenges, the solutions to which are often related to behaviour and practice. The group reflected on how academics can

struggle to align this personal motivation with career prospects. Those who succeed often do both IDR and disciplinary research at the same time. Some attendees felt that this required them to work essentially on their own time, which is very demanding.

How can the quality of IDR be assessed?

The quality of research is assessed in a number of ways for a range of purposes. The group was asked to explore how the quality of IDR should be assessed. Quality and IDR, balance, peer review, and evaluation and systems emerged as key themes.

Quality and IDR

Participants discussed how quality is understood in academia and recognised the different approaches to research across the disciplines. The consensus was that the criteria that apply to assessing the quality of research in general also apply to IDR. It was noted however that it was important to remember that not all IDR looks the same.

Balance

The relationship between research and teaching within the universities was discussed. It was argued that for many participants, they used to complement each other more effectively. Research and teaching were both considered 'scholarship' – but it was felt that the increasing focus on delivering for the REF has affected the balance.

Peer review

There were conflicting opinions across the group about interdisciplinary expertise in peer review. Some researchers felt that peer reviewer expertise should mirror the interdisciplinary expertise involved in the research being assessed. Others felt that strong disciplinarians with interdisciplinary experience should review proposals and publications. The onus is also on researchers to be aware of the disciplinary home where the research is understood, what the expectations are in that discipline, and how their research should be positioned. For example, it was highlighted that creative tourism is better received in media studies than in tourism.

The REF was raised repeatedly by many different participants. REF impact cases have incentivised support for IDR and have provided a way to demonstrate its value. Participants indicated that the UoA structure did not create a natural home for IDR. The existence of the cross-referral process in REF did not deter the researchers from this view. The group noted that in the context of an ongoing review of REF, universities are cautious about developing activities to enhance impact cases (often IDR-based). One Pro Vice-chancellor (PVC) mentioned that they avoided cross-referencing publications in REF so that the research was not seen as stronger in one field and weaker in another.

Evaluation and systems

Comments were also made about the use of metrics: current metrics tend to measure individual performance and do not capture collaboration. Methods of assessment or metrics which can measure collaboration could help remove barriers to IDR. The group felt that both qualitative and quantitative assessment should be maintained. It was suggested that alternative measures could be considered; for example, user impact was proposed to assess practice-oriented research. For outputs other than journal or conference publications, dissemination could be used as a metric. Researcher development, which adds value to IDR

collaborations, was also highlighted as an area that should be assessed and rewarded. It is important to note here that staff development is an existing feature of the REF Environment Template. However, it was noted that non-traditional metrics may be seen as lower quality than traditional metrics within the sector.

The group felt that in order to develop fair and robust evaluation, the academic community needed to build a consensus about what 'good' research looks like. It was noted that it was important to know what the quality assessment, whether internal to the institution or external, will be used for. The participants highlighted that the uses of assessments can have downstream consequences.

A.3.3 Cluster wall

The first phase discussions were clustered by participants and reviewed by the chair and facilitator leading to nine overall themes relevant to IDR:

1. Fundamental theory about what IDR does
2. Assessing quality
3. Institutional cultures
4. Support for IDR
5. Leadership
6. Impact
7. Publication issues
8. Training and researcher development
9. Incentivisation

A.3.4 Pitches

Participants selected a theme from the list which they felt was most important leading to six pitch teams. They were: institutional culture, leadership, impact, quality, and fundamental theory. The pitches are summarised below. At the end of the event participants were asked to vote for the issue they felt was most important.

Institutional culture (7 votes): Funders, the EU, government, and HEIs are all institutions. The common challenge for all of them is to get the culture, values, environment, and incentives right. Existing systems can be deeply entrenched, but changing them and making them more effective provides the opportunity to access new funding streams, develop strategic partnerships, create impact, enhance reputations, and support individual careers.

Leadership (4 votes): Good leaders can help to change culture in universities. They can establish centralised facilities and conduits for IDR. Good academic leaders add value and become role models for others. Research councils should consider alternative models for supporting IDR which would need leaders to support change.

Quality assessment (4 votes): This issue is important for IDR because resources are constrained. The challenges are benchmarking across and between disciplines, and assessing individual contributions in a team project. The opportunities are to develop robust structures for assessing quality that are able to effectively consider benefits and risks.

Fundamental theory (3 votes): Engaging with IDR will lead to an academic community with broader horizons and better capacity to solve global challenges. However, there is no underpinning theory for nurturing IDR and convincing people from different disciplines to collaborate is difficult, creating a 'safe fail' environment for IDR rather than a 'fail safe' environment.

Impact (3 votes): IDR can make a difference to people's lives, generate novel and interesting ideas, and lead to innovations. Such impact can be publicised to a wider audience and be presented in case studies for REF. The challenges, however, are related to REF – the disciplinary UoA structures which might make it difficult to position the IDR, the need for different research metrics for impact, and the extra time required to achieve impact. Different definitions of impact further complicate this area.

A.4 Funders' Round Table: 14th March 2016, London

A.4.1 Workshop structure and participants

The workshop was chaired by HEFCE and was structured as a roundtable discussion with the aim of obtaining funders' and policymakers' views, and sharing experience and intelligence. The 11 participants who attended the workshop represented a variety of UK funders including funding councils, research councils, and charities. Discussions centred around three main topics:

1. Lessons from funding initiatives
2. Barriers for IDR
3. How to address the barriers

A.4.2 Lessons from funding initiatives

UK funders have funded IDR using a range of mechanisms amongst which large theme-based programmes are often most prominent e.g. for health and wellbeing, energy, and global food. In addition, 'smaller' calls through different funders – some focussed on IDR and others more discipline-specific – have been an active part of the landscape. The participants discussed different types of calls and factors that affected their success including time, project management, and leadership.

Types of initiatives

The participants noted that different types of initiatives have varying success rates. There is no one approach that guarantees success.

Large grants

There was consensus that challenge-driven funding calls which award project grants (3-5 years) to address real-world problems such as food security, energy, ageing, etc. typically

require an interdisciplinary approach from researchers. The perception was that real-world challenges tend to appeal to people irrespective of their academic specialisms. According to the participants, strategic calls for innovation were also effective in breaking down disciplinary boundaries.

Other approaches that were discussed included larger critical mass approaches, which allow large groups/projects the necessary flexibility to undertake IDR. These long-term investments allow co-location of teams and provide role models and beacons for IDR. However, imposing collaborations was universally acknowledged as undesirable.

Small grants

Another model of funding that several funders had used was smaller investments for networking and researcher development including learning another discipline's language to help reduce communication difficulties between disciplines. Specific examples were bridging-the-gap awards, feasibility studies and 'pump-priming' which is commonly used in cross-council projects. In general, the aim of these investments was to move from facilitating and supporting 'small pockets' of emerging work towards funding large projects as and when these became possible. Consequently, the group remarked that small investments can eventually lead to big impacts.

Initiatives and mechanisms that bring together people and disciplines that would not normally meet e.g. networking events and leadership programmes, have also proved successful. Challenge-led endeavours are a driver here, because real-world challenges seem to appeal to researchers irrespective of their academic specialism.

Training grants

The group noted that Doctoral Training Centres (DTCs) that are co-funded between two or more research councils often prioritise IDR practice. Co-supervision from different disciplines was seen as positive and conducive to building IDR capacity. DTCs were also noted to have an added value in bringing faculty together in an interdisciplinary way.

Nesta's Crucible programme² was highlighted as a good initiative to foster an IDR culture among ECRs as well as more widely in the department where they were based. Discipline hopping grants were mentioned as another initiative to foster interdisciplinary mind-sets, but may not help to develop capacity in fields where attitudes are more rigid. In addition, funding towards courses for building the requisite research skills such as conducting interviews and social science methods was also recognised as being useful.

Factors for success

Time

It was noted that IDR requires extra time, not only for the project itself (as researchers need to learn to 'speak each other's language'), but also to develop funding proposals and build teams. However, finding funding for this 'extra' time is challenging. Enabling networking

² <http://crucibleinabox.nesta.org.uk/>

activities as well as allowing and committing time through instruments like workshops and seed funding were re-iterated as being critical to foster IDR.

The funders also raised the need for long-term commitments to develop a new IDR area. They emphasised that going incrementally from small to large grants was crucial, as the smaller calls 'spread the message' in the community and allowed capacity building and preparation for future calls. Careful monitoring of investment in particular topics was highlighted as being important to achieve a balance between supporting established and emerging fields of research.

Management and leadership

The group reflected that, just like researchers, funders need to work together from the start when collaborating on co-funded initiatives. They need to develop an understanding of the 'cultural' differences and language of each funder as well as the different communities involved in the research in order to develop initiatives that are coherent and effective in addressing the underlying research question.

Leadership of IDR projects/institutes was also highlighted to be crucial. The group emphasised the positive impact of good communication, able leadership and efficient project management on the success of IDR. It was noted that IDR may require more project management and management support than monodisciplinary research. This was particularly crucial for challenge-led research endeavours where distances between disciplines, involvement of users/non-academic stakeholders or experts, and involvement of international collaborators spread over different locations may add further layers of complexity for project management.

The participants highlighted that a lack of trained and experienced project managers, data managers, and other service/support staff for IDR projects could create challenges for inexperienced researchers who might have to take on these roles themselves. While larger research projects/centres tend to have a full-time project manager, smaller projects that do not merit a standalone project manager may encounter problems given the greater management challenge of IDR. Moreover, since these types of support roles are often viewed as low status and involve temporary work, retaining these skills over the long term can be a problem.

Proportion of total funding for IDR

Funders noted that it is extremely difficult to estimate the volume of IDR as a proportion of total research, as IDR is also funded outside designated strategic programmes. Depending on what is counted as IDR, funders estimated 100% to 30% of their research as being IDR. However, funders also acknowledged that current proxies for IDR such as departmental affiliations of IDR team are inadequate.

A.4.3 Barriers and how to address them

Funders identified the following factors as being barriers to IDR:

Time and space

Time and space were both identified as important considerations for IDR. The arguments regarding the importance of time in IDR have been discussed in the previous section.

The group mentioned that constructing physical spaces on campuses for conducting IDR and fostering interaction between disciplines is an emerging practice. In the last 20 years, new infrastructure building has become about co-location of different disciplines. The Francis Crick Institute is an example of this approach. Similarly, for health-related projects, some universities co-locate research facilities in hospitals to allow better contact between researchers, medics, and patients.

The hub and spoke model which is exemplified by the Farr Institutes³ was also mentioned as an alternative.

Space was noted to be a legacy issue because university departments and faculty have traditionally offered recognition and rewards in less translational areas. In such cases, the critical element was identified as interactions between people who would normally not interact. 'Water-cooler moments' where people from different disciplines can bump into each other and develop contacts were perceived to be lacking in the current environment. Virtual networks and electronic environments were proposed as alternatives to physical space in this regard.

Peer review

Peer review of funding applications is a very important issue in IDR. Researchers have raised concerns about 'double jeopardy' and 'falling through the cracks' in assessment. Anecdotal evidence from researchers and funders suggests that IDR scores lower in peer review and a false hierarchy can be created between qualitative and quantitative disciplines or with disciplines seen as service-based in a project. With these points in mind, funders discussed issues like reviewers, review systems, research evaluation, and risk.

Reviewers

The group agreed that getting the right peer reviewers for IDR and interdisciplinary publications can be a challenge. The attitude and expertise of reviewers is critical and conservatism or inexperience with interdisciplinary projects can influence their willingness to be involved in assessment. There was consensus that more IDR peer reviewers and better mechanisms to identify them are required to solve this problem.

A critical inconsistency was also noted: there is widespread desire among researchers for more IDR, and yet peer reviewing of IDR by researchers continues to be harsh.

Review systems

Pitches, review panels, and standing panels were proposed as alternative ways to review IDR. More peer reviewers per proposal or collaborative peer review were proposed as other options.

³ <http://www.farrinstitute.org>

Research evaluation

The funders felt that although IDR is welcomed in the REF assessment process, institutions may not be selecting IDR for their institutional submission due to uncertainty about how IDR would be perceived by panels.

Risk

The participants felt that academic reviewers may be inclined to support high-quality proposals which present clearer outcomes and lower risk even when actively encouraged to consider risk and benefit. Therefore, they recommended research that would help panels to judge the riskiness of projects more effectively and reward projects with good risk management.

A.4.4 *IDR: some wider points*

Some general comments about the nature of IDR were also made during the discussion as follows:

1. Strong disciplines are needed for strong IDR. (There was no consensus on this.)
2. Disciplines are temporal social constructs and the landscape is always changing; the IDR of today may be the discipline of tomorrow.
3. Teaching is often characterised by disciplinary lock-in, which may further cement the distinctions between disciplines.
4. Established disciplines sometimes see target initiatives as diverting funding away from their own research.
5. Consultation with the research community ensures buy-in, whereas top-down challenge-setting does not always work.
6. 'Learning other languages' can be an important transferable skill for research in general, not just IDR.

A.5 Strategic Leaders' Round Table: 23rd March 2016, London

A.5.1 *Workshop structure and participants*

Attendees included 15 strategic leaders (PVCs and research managers) from UK universities and university associations. Roundtable discussions were facilitated by a PVC of a university. The initial icebreaker activity involved three strategic leaders with different roles: PVC, Institute Director and Head of Research Development speaking about IDR and their roles.

Discussions were stimulated around the following questions:

- Is IDR a strategic research priority for your institution? If so what are the drivers for this?

- What is the role of IDR in your institution's research and knowledge exchange strategies?
- How do policies on reward, career progression, and internal research funding support IDR?
- Do you think researchers/institutions are less likely to submit IDR proposals/research outputs? If so, why?
- What sources of funding do you access to support IDR?

The discussions addressed several broad topics which are summarised below.

A.5.2 IDR as a strategic research priority: drivers and support mechanisms

The strategic leaders discussed drivers for IDR at the institutional level and approaches adopted by their universities to support IDR.

Drivers

The following incentives for supporting IDR at HEIs were identified:

Impact agenda

- IDR is a path to address societal challenges and solve real-world problems.
- IDR fits in well with knowledge exchange and innovation strategies.
- Inclusion of impact case studies and IDR in the REF encourages IDR activity in HEIs – however, REF is not the main objective.
- Inclusion in the terms of reference of Lord Stern's review of the REF

New opportunities

- IDR opens new intellectual perspectives and opportunities for researchers.
- IDR provides the opportunity to challenge existing structures and change how we think.
- IDR energises individual disciplines.
- IDR can foster partnerships between HEIs and external academic and non-academic partners.
- IDR provides access to more sources of funding e.g. strategic IDR funding schemes from Research Councils, Horizon 2020, Big Challenge Fund, etc.

Culture change

- IDR can motivate younger researchers when they see that research can be done in a different way.
- Graduate students can help to drive IDR by engaging academics in their projects.

Support mechanisms

IDR receives central support at most HEIs and several different approaches have been used to grow and support IDR within institutions.

Examples of initiatives

- Sandpit workshops and “idea factories” to encourage cross-departmental collaboration
- Summer schools and interdisciplinary networks that bring different disciplines and industry together
- Building research spaces that encourage a culture of sharing ideas
e.g. coffee rooms or other spaces that provide opportunities to meet other researchers
- Project development support e.g. from developing the idea to submitting a proposal
- Training researchers in IDR skills
- Interdisciplinary PhD projects involving co-supervisors from different faculties
- Summer schools in IDR skills for PhD students
- Joint degree courses
- Allocation of funding for defined strategic themes (e.g. environment, energy, vaccines) and platforms (e.g. photonics facility) with interdisciplinary reach and directors appointed for each theme
- HEFCE-supported programmes (e.g. 50% funding from HEFCE) that helps to catalyse new interdisciplinary activities
- University research fellowships, not necessarily just for IDR
- In one case, bringing undergraduates from different departments together inspired academics from across the institution to interact in a similar way. This initiative proved very rewarding for the academics who then produced very high-quality research. Funding councils can help facilitate these interactions.
- Another specific example is a 3-month international fellowship scheme with no stipend, just a small honorarium. The focus is on intellectual collaboration and not on outputs. Fellows are encouraged to produce joint journal outputs and proposals with the university’s academics, are paired with buddies, and are expected to give a lecture.

A.5.3 Barriers to IDR

The strategic leaders identified the following barriers to IDR:

The need for more time and resources

- IDR projects take longer to set up and to start running and timeframes like REF can act against them.

Disciplinary issues

- Subtle barriers exist around IDR identities, distrust of categorical ambiguity, and status.
- Having a defined academic identity rather than an ambiguous identity is important to academics.

- Smaller, specialised institutions may find it more difficult to conduct IDR because of lack of in-house expertise in other disciplines.

Communication

- Absence of a common language

Funding

- Perception that funding is not available
- Peer review of IDR proposals and outputs can be a struggle.
- Stakeholders, particularly funders, are risk averse.

Publishing

- Publishing IDR is difficult. However, this may not apply to all types of IDR. For instance, research concerning a very important real-world problem might be easier to publish in reputed journals.
- Better peer review, more journals for interdisciplinary research, and special IDR issues in established journals may circumvent this problem.
- Lower citations for IDR feeds into career decisions.

REF

- Perception that IDR cannot be submitted to REF
- HEFCE narrative on IDR is either not picked up by HEIs or misinterpreted
- Lack of clarity in academics' minds about how IDR will be assessed and rewarded in REF

A.5.4 Role of IDR in institutional research and knowledge exchange strategies

The participants stated IDR can be one bullet point in the strategy among other priorities or an underlying theme of the institution's strategy for research, external engagement, innovation, teaching, or internationalisation. Nevertheless, implementation depends on how institutional priorities are interpreted. Some HEIs include IDR as an objective in their research strategies by defining priority interdisciplinary themes; some have a low-key focus on IDR because they do not want to disadvantage disciplinary research; while others do not have a formal research strategy.

A.5.5 Funding

Types of funding

The group identified Horizon 2020 and Global Challenges Funds as most directly focussed on IDR. The easiest way to obtain such international funding was noted to be through linking with existing research clusters working on an important global problem e.g. climate change, migration, etc. This reinforces strong links between IDR and internationalisation. Plus, capacity is needed to attract international students and international faculty. Targets for co-authoring publications with international partners can also foster IDR. Other funding sources such as HEFCE, research councils, charities, and businesses were also mentioned.

Since time is the major barrier, buy-out of time spent on IDR was proposed as an incentive for IDR activity. An alternative model suggested funding academics' salaries from IDR grants from the research councils or Horizon 2020. Support for IDR centres or units through core institutional funding was also highlighted as a way of funding IDR.

Proposal evaluation

Disappointing feedback from peer review and conflicting assessments from disciplinary experts were seen to demotivate academics, resulting in fewer IDR proposals. The group felt that the Research Councils exacerbate this problem because their disciplinary remits make it difficult to 'fit' IDR to their requirements.

Finding people to peer review IDR is also difficult according to the participants. Suggested remedies to improve this situation were automated choice of peer reviewers from UoAs, experienced interdisciplinary researchers on review panels, and clearer assessment processes. Using other countries' review systems was also suggested as a viable option. For example, in Canada there is another layer of peer review involving international experts who judge interdisciplinarity, value to Canada, and impact.

A.5.6 *Facilitating IDR: practical considerations*

The participants stressed that just bringing people together does not guarantee successful IDR; they further elaborated on factors that HEIs ought to consider when conducting IDR.

Promoting IDR

Cracking faculty divisions was seen to be an important aspect of institutional support. The collegial structure in some universities was identified as an enabler of IDR. Organisation across specific research themes was mentioned as an alternative model. One university found this to be restrictive and advocated a more open approach where investigator-led and themed research projects are both supported. Moreover, continuous learning and subsequent adaptation of approaches was seen to encourage greater success, which can be measured in terms of research activity in the area, through grant income, and REF feedback. Appointing research champions to catalyse IDR activity was also seen as a viable option.

Interdisciplinary researchers and academic culture

Individuals were deemed to be the core resource, especially those with an appetite for IDR. Strategic leaders felt that, faced with researchers who do not perceive IDR as important, they were unable to do much to grow IDR.

Getting low Technology Readiness Level (TRL) researchers involved in IDR was identified as a challenge. This is related to where current IDR sits in terms of TRLs and the difference between basic and applied research. These researchers were expected to get out of their comfort zones and experience positive effects from interdisciplinary interactions.

IDR was perceived as a learnt skill – a 'café' style culture that requires a number of soft skills (openness, humility, jargon busting, leadership skills), which can be fostered through workshops.

Collaboration

Another key aspect of IDR was observed to be collaboration; analogies with orchestras were made. The need for interdisciplinary team members to trust each other and have the space and environment that allows them to develop a common language was stressed. Frequent interactions and a transformational change in how researchers address challenges was also considered important.

Initiatives like university networks, e.g. N8 and the White Rose Consortium, were also seen as useful ways to foster interdisciplinary collaboration, increasing value in some spaces, and facilitating proposal writing and IDR activities in general.

Early career researchers

Participants remarked that some senior researchers discourage ECRs from IDR because it is seen as detrimental to their career. Interdisciplinary PhDs are sometimes perceived as irresponsible and controversial because the low citation impact of IDR means that the ECRs are less likely to become known in their fields.

On the other hand, it was pointed out that many ECRs consider an interdisciplinary network as an essential tool in building a long-term career. A cohort approach was seen to help with networking, but finding the time to interact and develop the requisite skills was seen as difficult. Research fellows on fixed-term contracts were identified as being especially vulnerable. Increasing project time frames was considered as a remedy for this problem. Other alternatives like working with senior ??university?? colleagues, ignoring disciplinary boundaries, or IDR skills training as provided by DTCs were also mentioned.

Assessing the quality of research

Another topic of discussion was how to measure the success of IDR. Grant/research income, new streams of funding, new networks and partnerships with industry and government, number of international visitors engaged in IDR projects, and successful collaborations were all suggested as indicators of success. Support and contribution to interdisciplinary projects were proposed as indirect measures of success.

Interdisciplinary versus monodisciplinary research

Strategic leaders felt that IDR does not need to be opposed to disciplinary research. IDR can provide a foundation for the academy but should not be treated as a superstructure to which everything needs to fit. The crucial thing is to get people together, whether within disciplines or across disciplines. There is a need to go beyond disciplines, but there is widespread inertia in this regard. Research Councils and some senior academics replicate the disciplinary structures, which act as a barrier. On the other hand, catalyst and industry funding can help to create hubs of interdisciplinary activity, as can some senior academics who are more adventurous with their research. What is needed is a change in the way we perceive disciplines. For example, clustering research by key words would give a better picture of what people are actually doing rather than disciplines.

Appendix B Summary of Stakeholder Interviews

B.1 Purpose

The purpose of the ‘Landscape Review of Interdisciplinary Research in the UK’ is to explore which drivers and barriers for IDR exist in the UK research landscape through engaging three defined stakeholder populations: researchers, funders, and strategic leaders at HEIs. In this section, we describe our findings from interviews of these three stakeholder populations.

For the purpose of the study, the term ‘interdisciplinary research’ was used as an umbrella term for all research involving two or more disciplines including interdisciplinary, multidisciplinary, cross-disciplinary, and transdisciplinary research.

B.2 Summary

There were areas of consensus and contention within and across the stakeholder groups. We saw broad agreement in the following areas:

- The current status and future prospects of IDR in the UK are good.
- A desire to solve real-world problems, availability of funding, and intellectual curiosity are seen as drivers of IDR.
- Leadership at institution and project level is important.
- Collaboration in IDR is particularly important.
- IDR often requires additional time and effort, and resourcing this is challenging.
- Discipline-oriented institutional and departmental cultures can create academic and administrative challenges.
- Career progression structures do not always effectively accommodate researchers active in IDR.
- Identifying expert peer reviewers for IDR can be challenging due to the diversity of experience required.

We saw a lack of consensus on the following subjects:

- The REF panel structure was seen to preference disciplinary outputs by some of our interviewees but this view was not held consistently, with many highlighting that IDR was accepted and well received within the REF.
- Publishing IDR was identified as challenging, although this varied by discipline. This issue was highlighted as interdependent with concerns about career progression due to prominence of publications in recruitment, reward, and progression in HE.

B.3 Researchers

B.3.1 Sample

The 15 interviewees came from across the UK, career stages, types of institution, and research fields (Table 2). All except one – who is spending about 20% of their time on disciplinary research – are undertaking IDR full time. The majority of the ECRs interviewed had a strong IDR background, having studied in different fields during their Bachelor’s and

Master's studies. Similarly, the majority of senior researchers have also been conducting IDR since their PhDs or postdoctoral studies.

Table 2 Researchers' interview sample stratified by home discipline, institution type, geographical location, career stage, and gender

| <i>Home discipline</i> | STEMM | | | AHSS | |
|------------------------------|---------------------------------|---------------------------------|-----------------|--------------------|-----------|
| | 6 | | | 9 | |
| <i>Type of institution</i> | Large research-intensive | Small research-intensive | | Post-1992 | |
| | 7 | 3 | | 5 | |
| <i>Geographical location</i> | North England | South England | Scotland | Wales | NI |
| | 6 | 5 | 2 | 1 | 1 |
| <i>Career stage</i> | Professor | Lecturer | Postdoc | PhD student | |
| | 4 | 3 | 5 | 3 | |
| <i>Gender</i> | Male | | | Female | |
| | 5 | | | 10 | |

B.3.2 Defining interdisciplinary, multidisciplinary, crossdisciplinary, and transdisciplinary research

Interviewees were asked to articulate their understanding of interdisciplinary research. As expected there was no consensus about terminology. The majority of participants used the term 'interdisciplinary', and many did not recognise any difference between the various terms. One interviewee preferred the term 'postdisciplinary'. He identified the current terms as deeply rooted in the "disciplinary way of thinking" and therefore restrictive to a healthy IDR environment. The majority of participants agreed that terminology is not as important as practical application.

B.3.3 Drivers of IDR activity

In general, senior researchers and ECRs agreed on the factors that acted as personal drivers for conducting IDR: academic curiosity combined with research need. There was general agreement that complex societal challenges often need to be approached combining a range disciplines and methods. Other motivations included the scope for producing high-

quality research and IDR's application to industry which was seen as a benefit when pursuing employment in the private sector.

B.3.4 Role of IDR in HE research policies

Some senior researchers identified the REF and journal structures as encouraging disciplinary pursuits whilst the increasing focus on grand challenges in responsive funding from different organisations supports researchers to cross boundaries.

Among the ECRs, the overall consensus was that HE research policies affect institutional policies. In this context, some ECR respondents felt that explicit integration of IDR into HE research policies is not necessary and that creating suitable conditions for researchers is enough.

B.3.5 Support of IDR in the UK

The majority of interviewees did not express particular concerns about funding or other infrastructural support for IDR in the UK. However, some individuals expressed a strong dissatisfaction with the overall level of support in their own research area including lack of funding for equipment and what was seen as disproportionate support for science, technology, engineering, mathematics, and medicine (STEMM) subjects at the expense of the social sciences.

B.3.6 Support of IDR at institutional level

Some institutions were described as providing verbal support for IDR whilst lacking underpinning practical support. However, some interviewees acknowledged positive support for IDR at universities through funding opportunities and structural changes such as organising research around themes. Although some researchers reported positive experiences of institutional support, it was felt by some that interdisciplinary researchers had to argue their cases more effectively at internal performance and promotion panels.

B.3.7 Influence of institutional and/or departmental cultures

Most researchers responded that institutional cultures were different from one institution or department (or discipline) to another and depended greatly on the individuals involved. For instance, some individuals see IDR as a potential threat to their discipline and/or institutional/departmental vision and hence are not supportive of colleagues who conduct IDR. Alternatively, a lack of awareness about IDR in the wider university was cited as a reason for low participation in IDR projects. Communication between departments was highlighted as a significant challenge.

B.3.8 Experiences with publishing IDR

There was no consensus on whether the current publishing landscape creates a barrier for IDR. Some claimed that the key is to target the right journals that are open to IDR outputs. Our understanding is that the ease of publishing IDR is dependent on discipline.

The issue facing researchers attempting to publish IDR is whether to publish IDR in specialised journals or tailor their research to disciplinary journals which have higher impact factors. Therefore, researchers adopt different strategies in order to publish their work:

- Do disciplinary work in addition to IDR and publish 'career papers'
- Publish in IDR journals (more accepted in some disciplines than others)
- Extract the disciplinary element of IDR and publish in disciplinary journals
- Publish in non-standard formats, e.g. special issues or edited books

B.3.9 Training of researchers

There was an overall consensus that researchers need to have a strong and solid background in one discipline, but that PhD students ought to be 'exposed' to other disciplines to understand the limits of the disciplines. A suggestion was to include additional modules during undergraduate or postgraduate studies that provide baseline knowledge in other disciplines.

B.3.10 IDR and career paths

Opinions differed on how IDR fits in a research career. Some said that it can be extra work to build an academic career solely in IDR but that it is achievable. Employment in university departments may be easier for people with single discipline profiles where career paths are more clearly laid out. Therefore, researchers may need to maintain a strong home discipline conducting single and interdisciplinary work simultaneously.

It was noted that ECRs particularly need to understand that IDR can be a big career commitment and what the consequences of their choices can be.

B.3.11 Collaboration with external non-HE partners

The interviewees strongly agreed that collaboration with external partners was important to validate IDR and gain different perspectives such as from the business sector. In this regard, the necessity for networking opportunities was highlighted.

However, they also noted that collaboration takes time to establish and requires networking skills that have to be learned. Some talked about difficulties in understanding colleagues from other disciplines or in developing a mutual understanding between researchers and industry partners. Conflict of interest with non-HE partners was also raised as an issue, for example in terms of which elements to emphasise to improve the 'return' in different disciplines, and about whether or not to publish certain results.

B.3.12 Role of leadership

All interviewees agreed that IDR needs capable leadership at the institutional, departmental, and project levels.

At the institutional level, university management should acknowledge and reward good interdisciplinary work.

At the departmental level, the role of leaders was seen particularly in facilitating team research, providing funding, and encouraging people. Openness to different types of research and researchers that do not necessarily fit any discipline was also counted as important.

At the research group or project level, some argued that a good leader should leave space for other (younger) researchers to express themselves and act like a mentor or master apprentice. Particularly in IDR, leaders need to achieve a balance between different, sometimes conflicting, points of view while keeping the project together and making decisions.

Leaders who have a vision and narrative for IDR in their research field were noted as being important, but missing from the current landscape.

B.3.13 Submitting to REF 2014

Six of the seven senior researchers interviewed had submitted work to REF. Among the others, only one had submitted outputs to REF 2014. In general, there was a low awareness about the REF process among junior researchers.

Researchers had submitted their outputs (interdisciplinary or otherwise) as units or to individual disciplinary panels. One interviewee described their first experience of submitting to the REF as a unit as positive. Another noted that a minority of international development studies groups use this structure, which is why this field does not have its own UoA. Where IDR outputs had been submitted, they were reported to be well-received. However, some researchers had submitted more non-IDR articles, or articles where the IDR elements were de-emphasised because of their uncertainty regarding how IDR would be viewed by the panels.

Conversely, some researchers saw REF as a driver for IDR because of signals from their subject subpanel. Accordingly, a misperception that IDR cannot be submitted or is disadvantaged in the REF was identified to be the problem. Others viewed a REF that was based primarily on disciplinary research as natural, but not necessarily helpful for IDR. Inclusion of 'IDR champions' in the assessment panels was suggested as a way to improve the visibility and assessment of IDR in the REF.

B.3.14 Additional barriers to IDR

Since IDR often requires additional time and resource to develop and can be viewed as a riskier prospect, these were identified as additional barriers to IDR by some of the interviewees. Indeed, a lack of communication (across teams, departments, and/or

institutions), a lack of awareness of available support for IDR, and a lack of drive of individual researchers to conduct IDR were also seen to inhibit IDR activity.

Lack of funding and infrastructure was not identified as a specific barrier, despite the consensus that more funding is required for research in general. However, a need for funding structures, especially those of the Research Councils, to be more interdisciplinary was highlighted by some.

ECRs specifically mentioned two additional barriers – the lack of conferences that allow interdisciplinary ECRs to get recognised and establish networks, and the disciplinary set up of the educational system (starting from GCSEs and A-levels onwards).

B.3.15 Current status of IDR in the UK

The interviewees were largely positive about the condition of IDR in the UK, following increased attention from funders and changing cultures within universities. Most of them were happy to undertake IDR again if they had the choice, but might have undertaken specific skills training earlier.

B.3.16 The future of IDR in the UK

The interviewees were generally very positive about what IDR would look like in the UK in the future. They described current trends as positive and that IDR will inevitably become the first choice of more researchers because disciplines as they are defined now will not be able to reflect the complex dynamics of real-world problems. In that regard, funding schemes like the Global Challenges Research Fund are expected to continue to support and motivate interdisciplinary researchers. Nevertheless, two interviewees warned that researchers could easily revert back to doing disciplinary research if the support for IDR is withdrawn.

In addition, researchers were optimistic about the opportunities for publishing and training in IDR as well as the overall support from HEIs.

B.4 Strategic leaders

B.4.1 Sample

We conducted interviews with senior management members at eight universities (including two Russell Group institutions, see Table 3). Interviewees variously held the positions of pro-VC, dean or director of research, or vice principal. In all cases, they had a broad remit, covering strategic oversight of research (and in some cases innovation and knowledge exchange) at their institution, where IDR was typically an explicit constitutive part.

Table 3 Strategic leaders' sample stratified by home discipline, institution type, and geographical location

| <i>Home discipline</i> | STEM | | | AHSS | |
|------------------------------|---------------------------------|---------------------------------|-----------------|------------------|-----------|
| | 5 | | | 3 | |
| <i>Type of institution</i> | Large research-intensive | Small research-intensive | | Post-1992 | |
| | 2 | 4 | | 2 | |
| <i>Geographical location</i> | North England | South England | Scotland | Wales | NI |
| | 2 | 2 | 2 | 1 | 1 |

B.4.2 Defining interdisciplinary, multidisciplinary, crossdisciplinary, and transdisciplinary research

Our interviewees largely noted that the plethora of different terms rarely appears especially salient. However, all acknowledged that there is a broad binary distinction: on one hand, large projects that involve experts from different disciplines coming together, each adding their disciplinary expertise to a project ('multi-' or occasionally 'cross-'); on the other, researchers or projects where two or more disciplines are actually fused to the effect of creating genuinely new methodologies or approaches, where the individual researcher transcends at least to some extent their original 'home' discipline ('inter-' or very occasionally 'trans-'). Beyond this basic divide, few further distinctions were made, and the various terms were not applied with absolute consistency across the interviewees.

B.4.3 Drivers of IDR activity

Strategic leaders identified two principal motivations for institutions to support IDR. The first, and generally the more immediate motivation, derives from the wider policy and funding landscape, and specifically from the growing focus on challenge-led endeavours. Funders increasingly make money available for projects or centres that focus on a particular challenge rather than a particular discipline (e.g. climate change, health). These almost categorically require a degree of inter- or multi-disciplinary activity. From the point of view of securing these funding pots, there is a clear motivation for institutions to encourage IDR.

Secondly, our interviewees frequently pointed to more organic and cultural factors: many researchers themselves have an interest in engaging in interdisciplinary work, either because they want to make their work as relevant as possible to wider society, or due to

intellectual curiosity. Many identified IDR as a source of particularly innovative and exciting research, potentially leading to the formation of entirely new disciplines. Though some interviewees identified this as a direct institutional motivation for supporting IDR, it was generally expressed as a wider driver for IDR.

Some interviewees also noted that their institutions had a track record, history, or reputation for IDR, and that this in turn attracts prospective staff with similar interests. In these institutions, there was a sense that IDR becomes in part a self-perpetuating emphasis.

B.4.4 Influence of national HE research policies on institutions

There was universal agreement among our interviewees that there is a fundamental duality in the current research policy landscape: on one hand there is grant funding, where the trend is towards challenge-led endeavours that involve IDR at some level (especially for larger projects and centres). On the other, there is QR funding, which is distributed through the strongly discipline-based REF. Although many noted that REF is of course open to submission of IDR outputs, it is (and, as noted by many, needs to be) fundamentally structured around disciplines (UoAs). Consequently, IDR is seen by researchers as an exception that the structure is able to accommodate rather than the rule for which the structure is designed.

However, there was disagreement, or in some cases uncertainty, around whether this dualism in fact constitutes a problem. Most interviewees noted that strong IDR capabilities need to be based on strong disciplines and disciplinary expertise, so fostering both mono- and interdisciplinarity is appropriate. But several also noted that that these two streams cause problems for individual researchers who might have difficulty in reconciling these two quite different emphases. Ultimately, the need to produce a REF submission and demonstrate excellence within a single discipline tends to triumph.

B.4.5 Role of IDR in UK HEIs

On the basis of their experiences the interviewees judged that between 20% and 50% of research activity at their universities is interdisciplinary. Most of their institutions include some form of interdisciplinary activities within their institutional strategy. This often revolves around particular challenges or themes, where an HEI has interdisciplinary expertise and a strategic commitment is expected to further boost this.

B.4.6 Institutional support for IDR

Again two distinct approaches for supporting IDR became evident from the interviews. The first centred on internal funding instruments and took a number of different shapes:

- Some institutions have designed what might be termed a ‘funding ladder’, moving from small research groups to large centres. Applications could be made internally for seedcorn funding and facilities to start up small research units. In some cases QR funding was heavily used for this, in others there was an obligation on the group to secure some external funding as well. Where good results emerge and larger

amounts of external funding are secured, groups may be elevated to the status of a centre.

- Some institutions assessed their strengths and then formalised these into cross-departmental units or centres, which interested parties (within or beyond the university) could then join.

Across both models, institutions sometimes designate the thematic focus of the IDR activities, whilst in other cases these are open calls. Several interviewees noted that too much of a top-down prescription was not advisable, and that some level of consultation with the researcher community was essential in defining the topics and themes of the IDR activities to conduct.

The second approach noted by our interviewees was of a 'softer', cultural character. The focus here was to encourage collaboration in several ways, including:

- Organising 'sandpit' events for researchers to discuss informally whether and what kind of IDR activities and projects might be feasible and of interest
- Ensuring the availability of physical spaces where individuals from different disciplines or departments/schools are able to meet regularly so that the initial contact ('water-cooler moments') necessary for IDR activity can take place
- Designating or appointing explicit IDR champions at the level of senior researchers or management to (a) signal to the researcher community that IDR is desired by the institution and (b) to have an open contact point for anyone contemplating to embark on an IDR project
- Clearly stated and often re-iterated commitments from university management to IDR in order to demonstrate to researchers that they will be supported, should they think about starting an IDR project
- Projecting an institutional culture and emphasis on IDR outwards, so that researchers with a similar outlook are more likely to apply there for jobs

B.4.7 Influence of institutional and/or departmental cultures

Interviewees disagreed on the extent to which departmental cultures act as barriers to IDR. Most had seen or experienced some instances of disciplinary protectionism over the course of their career, but few noted that this was a central problem. Areas of concern were lack of spaces and opportunities for contact, especially at institutions with geographically distant campuses, or where different disciplines were physically cut off from each other in any other way.

As noted above, institutional cultures were often noted as being potentially conducive to IDR, where efforts are made to signal a clear commitment to IDR and to support individual researchers in such endeavours.

In one case, there had been difficulties because an interdisciplinary centre had been originally attached to a particular department, which meant that researchers from other departments were reluctant to join, as it seemed to be somebody else's 'home-turf'. Keeping the centre unchanged in physical terms, but elevating it organisationally to the institutional level meant that it was administratively 'lifted above the departmental barriers', which led to researchers from other departments being more confident that their involvement would be welcomed.

B.4.8 Role of collaboration with external non-HE partners

Many interviewees acknowledged that non-HE partners often have a role in IDR projects due to the challenge-led nature of many IDR endeavours. However, there was little sense that any problems concerning the involvement of non-HE partners were intrinsic specifically to IDR. Problems, if any, were often described as the ‘usual issues’, such as differing timelines, pressures, and priorities, and issues around intellectual property and patents.

B.4.9 Assessing IDR

Further to the issue of REF having a disciplinary structure, many interviewees specifically commented on the difficulty of submitting IDR outputs to the REF. It was noted that the critical issue around research assessment was risk. Whilst many acknowledged that, contrary to common belief, IDR actually does well in the REF, submitting IDR entails a level of risk that monodisciplinary outputs do not. It is unclear who will be assessing the output, and how experts from different disciplines will rate it – that is, whether it will receive positive reviews from all constituent disciplines. Moreover, the positive performance of IDR outputs in the REF is not well known in the researcher community, adding to the hesitation to submit IDR outputs for the REF in the first place.

There were few substantive suggestions about how to mitigate this problem: the feeling was that monodisciplinary outputs submitted to monodisciplinary panels will always be viewed as the safer option. However, several noted that publicising and disseminating the finding that IDR does well in REF would be helpful. A few interviewees also noted that a useful step would be clear and outspoken statements by REF panels that IDR submissions are welcome and encouraged.

B.4.10 Additional barriers to IDR

To re-iterate, the barriers frequently noted in our interviews with strategic leaders were:

- Lack of natural interaction and dialogue between disciplines – especially where physical spaces or general proximity are unavailable
- Lack of outspoken commitment by institutions or communication of the institutions’ preparedness to support IDR endeavours
- Risk aversion around submission of IDR outputs for REF
- Relatedly, the opposing streams created by trends in grant funding on one hand and the perceived discipline-based demands of REF on the other

B.4.11 UK IDR now and in the future

There were mixed views about the current and future state of IDR in the UK. The increasing emphasis on IDR was broadly welcomed and further moves in this direction were viewed as somewhat desirable, particularly for tackling grand challenges and ensuring an innovative research landscape. There were some concerns about maintaining strong disciplines and

the risk that some disciplines are able to constructively embrace IDR whilst others may be 'left behind'.

Likewise, there were concerns that the culture of the UK's research sector, alongside the research assessment methods, might stifle further positive development. Risk-aversion and lack of a cultural drive towards IDR, as well as presence or lack of incentives, opportunities, and a 'funding ladder' were felt by some to potentially undermine further progress. In general, positive trends were acknowledged, with some cause for trepidation around structural or cultural issues.

B.5 Funders

B.5.1 Sample

Eight strategic leaders or managers from funding bodies were interviewed to explore the perspective of funders. Of these two were from learned societies (one STEMM, one AHSS), two belonged to trusts, one was from a Research Council, one was from a government department, and two were from regional HE funding bodies.

B.5.2 Defining interdisciplinary, multidisciplinary, crossdisciplinary, and transdisciplinary research

Funders were not overly concerned about the semantics of the aforementioned terms apart from as an accurate description of the research being done. They were keen to stress that they supported all types of research providing the approach was appropriate to the question.

B.5.3 Drivers for IDR and motivation to support IDR

The consensus was that research problems of practical relevance often benefit from an interdisciplinary approach and that funders' motivation to support IDR stems from the desire to support good-quality research. Other drivers included the policy context, users' needs, motivated researchers, and intellectual curiosity. IDR was also noted as being effective for translating research to practice.

B.5.4 Role of IDR in HE research policies

Most funders did not comment on this topic apart from the fact that IDR features in the research strategies of many HEIs. With regarding to HE itself, most participants felt that it was beneficial to develop specialisation in one field before undertaking IDR.

B.5.5 Incentives for IDR

Most interviewees felt that specific incentives are not required, rather disincentives need to be removed. Incentivising IDR at the expense of disciplines was seen as counterproductive. Even those who felt that incentives are needed recommended careful thought regarding the

types of incentives to be offered. Suggested incentives included favourably rating interdisciplinary projects proposed by able disciplinary researchers or small amounts of funding for exploratory work.

Some interviewees proposed co-location in institutes and internal lectures as ways to facilitate IDR.

B.5.6 Funding and support mechanisms

At present, most funding and support mechanisms are not set out to be interdisciplinary, although IDR is often the recommended approach when applied research or global challenges are involved. Global and practical problems are often the focus of strategic funding calls. In addition, general funding streams and fellowships are also expected to be inclusive to IDR, even though it may not be a specific priority.

The regional funders provide block grants to HEIs with no condition or expectation, leaving the individual HEIs free to allocate funding as and where they wish. However, some have a strategic pot too, which is used to grow critical mass or build networks in particular research areas. For example, the Welsh Government supports three thematic networks⁴ of researchers in Wales – low carbon, energy, and environment; drug discovery; and materials and engineering – and encourages them to submit joint applications. They also fund research capacity and infrastructure building initiatives, although not particularly for IDR. The Scottish Funding Council has had similar initiatives like the Research Pool Programme and Innovation Centre Programme⁵.

Research Councils also fund networks, sandpits and large grants in addition to DTCs and infrastructure. Cross-Research Council structures facilitate the cooperation of the 'disciplinary' research councils to fund IDR.

B.5.7 Assessing IDR

Among the funders interviewed, peer review is predominantly undertaken through external peer review and disciplinary as well as interdisciplinary review panels/boards. A broad range of disciplines and skills are represented on these review panels to allow each application to be reviewed fairly and thoroughly. This approach is taken in an attempt to prevent proposals 'falling between the cracks'. Panels have proved to be extremely useful when there is limited consensus between reviewers from different disciplines. Pitches rather than proposals was suggested as another alternative to circumvent the difficulties posed by disciplinary peer reviews.

Most of the interviewed funders find it difficult to find peer reviewers who are sufficiently knowledgeable about IDR. One charity funder, however, does not appear to have this

⁴ <http://gov.wales/topics/science-and-technology/science/growing-research-in-wales/national-research-networks/?lang=en>

⁵ <http://www.gov.scot/Topics/Education/UniversitiesColleges/16640/UniversitiesColleges>

problem. They attribute this to having international as well as non-academic experts on panels and boards. As non-academics are included, researchers have to present their research in non-technical terms which helps the reviewers, regardless of their background, to understand the proposed research better.

Across our sample, research is typically evaluated using the standard evaluation mechanisms of the funder in question, which tend to be the same whether the research is interdisciplinary or not. This generally takes the form of annual reports, meetings, and evaluation of outputs such as publications, patents, prizes, and supervision of doctoral students. Most funders were aware that IDR outputs can be different and that their evaluation systems need to be able to accommodate non-standard outputs.

B.5.8 General barriers to IDR and their mitigation

The following general barriers were highlighted by the interviewees:

- Longer time to develop and conduct IDR
- Institutional structures and culture that are disciplinary in nature
- Lack of networking opportunities for researchers
- IDR publications may have many authors so assigning credit to individuals can be difficult; they may take longer to publish and may not be rated in the same way.
- Developing REF submissions could be a barrier, depending on how IDR is dealt with by submitting HEIs .
- IDR can be perceived to be riskier and hence may be less likely to be submitted (to funders and the REF) and/or funded.
- IDR career paths are more unusual so promotion may be more difficult.

Building a culture and systems that appropriately value IDR as well as non-traditional outputs was seen as the key consideration for lowering barriers to IDR. Strong leadership or role models in key institutions were recognised as important to drive such changes.

One suggestion to achieve this was to have flexible HE structures that allow different disciplines to work together. Current structures such as funding bodies focus on narrow issues or fields which may work for basic research, but may disincentivise other types of research. For applied research, other skills and knowledge may need to be accommodated structurally in the HE system.

In combination with structural changes, interviewees emphasised the importance of effecting cultural changes through evidence-based conversation, and involvement of the research community, institutions, and funders. Moreover, it was noted that cultural change has to permeate to all levels of institutions and funding bodies.

B.5.9 Role of collaboration in IDR

Collaboration was seen as essential in an interdisciplinary context. Its contribution to form research communities around similar interests was also acknowledged. However, it was noted that collaborations with non-HE partners can be more challenging because of differing norms and expectations.

B.5.10 UK IDR now and in the future

The general consensus was that IDR in the UK is healthy, but needs more support. There is growing interest in IDR and with proper assessment criteria for applications as well as outputs, it was noted that IDR has the potential to make a valuable contribution in translating research effectively and addressing global challenges. Two future scenarios were presented – one where there is no disciplinary identity, and another where researchers have a twin identity. The ‘twin identity’ scenario, where researchers have a disciplinary home but also conduct IDR, is considered to be more likely.

Appendix C Survey Report

C.1 Survey methodology

Research in the UK's HEIs is conducted and supported within a large, diverse system, spanning the full range of academic disciplines and ranging from fundamental to applied research. The Higher Education Statistics Agency (HESA) identifies 206 distinct HEIs, while many more organisations fund research in the public, private, and third sectors. Funders range from dedicated research funding bodies, established to support research, to those that fund investigator-led research and/or commissioned research in order to support their strategic goals.

In the context of this complex research system, this study seeks to provide, within the time and resources allocated to produce this report, a cross-sectional view of attitudes to interdisciplinarity from across the core parts of the UK HE research system. To do so, three distinct perspectives have been identified:

- **Researchers** – who are employed at HEIs and pursue academic research
- **Strategic leaders and research managers** – who are employed in HEIs; they may be researchers in their own right, or in some cases professional service staff, but are approached principally to report from the perspective of the management positions they occupy, as those tasked with supporting the research of colleagues in their immediate organisational context
- **Funders** – managers in the public or third sector directly responsible for informing the allocation of research funding to HEIs (industry funders are not included in the study).

The study therefore focusses on the views of individuals on the barriers to and incentives for IDR that these different stakeholders perceive or have experience of, rather than of the official views of the organisations that they work for. Specific survey questionnaires were designed to gather data from these distinct perspectives using online surveys requiring 15-20 minutes of participant time. (The full set of survey questions is available in Appendix E.) Participation was invited by e-mail to maintain control of sample size and to increase the chances that the responses collected form a representative sample of the population.

A novel sampling strategy was devised for each target population given that the population for each group varies considerably (i.e. there are many more individual researchers than strategic leaders, and relatively fewer managers in funding organisations). This presented a challenge as statistics on the make-up of the target population are only available for researchers, and even here there is no comprehensive directory of HEI researchers. There is even less population level data available on those staff with research management duties at HEIs. Neither is there a comprehensive directory of staff managing funding allocation in research funding organisations. The study has therefore relied on novel methods for building population frames for each survey using available data and tailored approaches. Details of these are set out below, together with the associated sample populations and descriptive statistics of the respondents. The main advantages and limitations of each approach are also discussed.

C.1.1 Survey for researchers

We focussed the survey of researchers on 164 HEIs supported by the Higher Education Funding Council for England, Higher Education Funding Council for Wales, Scottish Funding

Council, and the Department for Employment and Learning, Northern Ireland – as reported on the websites of these organisations in May 2016.

According to HESA data for academic year 2014/15, the HEIs in our sample account for the entire UK population of 144,770 full-person equivalent (FPE)⁶ academics involved with research activities (i.e. individuals whose employment function is ‘research only’ or ‘teaching & research’). The organisations included in our sample are listed in Table 4.

Table 4 List of HEIs in the population frame of researchers by UK region (NUTS-1)

| | |
|---|--|
| North East (England) | |
| Teesside University | University of Newcastle-upon-Tyne |
| The University of Sunderland | University of Northumbria at Newcastle |
| University of Durham | |
| North West (England) | |
| Edge Hill University | The University of Bolton |
| Liverpool Hope University | The University of Central Lancashire |
| Liverpool John Moores University | The University of Lancaster |
| Liverpool School of Tropical Medicine | The University of Liverpool |
| Royal Northern College of Music | The University of Manchester |
| St Mary's University College | The University of Salford |
| The Liverpool Institute for Performing Arts | University of Chester |
| The Manchester Metropolitan University | University of Cumbria |
| Yorkshire and The Humber | |
| Leeds Beckett University | The University of Hull |
| Leeds College of Art | The University of Leeds |
| Leeds Trinity University | The University of Sheffield |
| Sheffield Hallam University | The University of York |
| The University of Bradford | York St John University |
| The University of Huddersfield | |
| East Midlands (England) | |
| Bishop Grosseteste University | The University of Lincoln |
| De Montfort University | The University of Northampton |
| Loughborough University | University of Derby |
| The Nottingham Trent University | University of Nottingham |
| The University of Leicester | |
| West Midlands (England) | |
| Aston University | The University of Birmingham |
| Birmingham City University | The University of Keele |
| Coventry University | The University of Warwick |
| Harper Adams University | The University of Wolverhampton |
| Newman University | University College Birmingham |
| Staffordshire University | University of Worcester |
| East of England | |

⁶ HESA defines full person equivalent (FPE) as ‘the (whole) person's working time engaged in a particular activity. FPE calculations are based on the activity taking place on 1 December of the reporting year’. This is distinct from HESA's definition of full time equivalent (FTE), which is ‘a unit that indicates the workload of an employee in a way that make workloads comparable to the standard full-time, full year contract’. Definitions and illustrative examples are available at:

[https://www.hesa.ac.uk/component/content/article?id=2923?\(accessed 19th of August 2016\)](https://www.hesa.ac.uk/component/content/article?id=2923?(accessed 19th of August 2016)).

Anglia Ruskin University
Cranfield University
Norwich University of the Arts
The Royal Veterinary College
The University of Cambridge
The University of East Anglia

The University of Essex
University Campus Suffolk
University of Bedfordshire
University of Hertfordshire
Writtle College

London

Birkbeck College
Brunel University London
Conservatoire for Dance and Drama
Courtauld Institute of Art
Goldsmiths College
Guildhall School of Music and Drama
Heythrop College
Imperial College of Science, Technology and Medicine
Institute of Education
King's College London
Kingston University
London Business School
London Metropolitan University
London School of Economics and Political Science
London School of Hygiene and Tropical Medicine
London South Bank University
Middlesex University
Queen Mary University of London
Ravensbourne

Roehampton University
Rose Bruford College
Royal Academy of Music
Royal College of Art
Royal College of Music
St George's Hospital Medical School
St Mary's University, Twickenham
The City University
The Institute of Cancer Research
The Royal Central School of Speech and Drama
The School of Oriental and African Studies
The University of East London
The University of Greenwich
The University of West London
The University of Westminster
Trinity Laban Conservatoire of Music and Dance
University College London
University of London (Institutes and activities)
University of the Arts, London

South East (England)

Buckinghamshire New University
Canterbury Christ Church University
Oxford Brookes University
Royal Holloway and Bedford New College
Southampton Solent University
The National Film and Television School
The Open University
The University of Brighton
The University of Buckingham
The University of Chichester

The University of Kent
The University of Oxford
The University of Portsmouth
The University of Reading
The University of Southampton
The University of Surrey
The University of Sussex
The University of Winchester
University for the Creative Arts

South West (England)

Bath Spa University
Bournemouth University
Falmouth University
Plymouth College of Art
Royal Agricultural University
The Arts University Bournemouth
The University of Bath

The University of Bristol
The University of Exeter
University of Gloucestershire
University of Plymouth
University of St Mark and St John
University of the West of England, Bristol

Wales

Aberystwyth University
Bangor University
Cardiff Metropolitan University
Cardiff University
Glyndŵr University

Swansea University
The University of Wales (central functions)
University of South Wales
University of Wales Trinity Saint David

Scotland

Edinburgh Napier University
Glasgow Caledonian University
Glasgow School of Art
Heriot-Watt University
Queen Margaret University, Edinburgh
Royal Conservatoire of Scotland
SRUC
The Robert Gordon University
The University of Aberdeen

The University of Dundee
The University of Edinburgh
The University of Glasgow
The University of St Andrews
The University of Stirling
The University of Strathclyde
The University of the West of Scotland
University of Abertay Dundee
University of the Highlands and Islands

Source: Authors' elaboration

In order to obtain e-mail addresses for as many researchers in the sample HEIs as possible, contact details of corresponding authors of publications involving at least one researcher based in the UK (as reported in publications' affiliation addresses) and published between 2013 and 2015 were extracted by querying WoS – an indexed database of research publications spanning a wide range of disciplines. 566,957 publications involving researchers based in UK HEIs from 2013 to 2015 were identified.⁷

We built our frame population on the assumption that a UK academic is research active if s/he is a corresponding author in at least one of the publications in the sample. To identify UK corresponding authors, we examined email addresses to identify those with domains ending in '.ac.uk'. This search identified 109,698 distinct email addresses hosted at UK HEIs from 219,182 publications (39% of the 566,957 publications in the sample). We then matched the email domains with those of the HEIs in our sample (e.g. "bath.ac.uk", "cam.ac.uk", "ucl.ac.uk").⁸ This resulted in a set of 105,839 unique email addresses for researchers representing 158/164 (96%⁹) of the HEIs supported by UK higher education funding bodies.¹⁰

This matching process also enabled us to identify the regional location (on the basis of NUTS-1 codes) of researchers in the frame population and to use this information to build a stratified sample by region with proportional allocation (De Leeuw et al., 2008; Heeringa et al., 2010). Key variables such as discipline, career stage, and gender of researchers cannot be determined from contact details reported in publication data. We therefore correct for these researchers' characteristics with *post stratification* weights based on HESA data (see next section).

The survey was sent to 19,055 e-mail address (18% of our frame population). 13% of these email addresses were invalid (likely to be due to typos when reporting emails in publications as well as to mobility of researchers), thus reducing our sample to 16,625 email addresses (16% of the frame population). 2,183 complete responses were obtained over a period of

⁷ The following search string was used to identify UK publications in WoS: "AD=(\"England\" OR \"Wales\" OR \"Scotland\" OR \"Northern Ireland\" OR \"North Ireland\" OR \"United Kingdom\" OR \"UK\" OR \"Great Britain\" OR GB) AND PY=(2013 OR 2014 OR 2015)". Raw publication data were provided by Thomson Reuters on 9 March 2016.

⁸ The extension "london.edu" was also included to identify email addresses of researchers at the London Business School.

⁹ Percentages have been rounded up to the nearest whole number in this study.

¹⁰ We could not identify email addresses from publication data for the following institutions: Conservatoire for Dance and Drama, Leeds College of Art, Liverpool Institute for Performing Arts, National Film and Television School, and St Mary's University College (Blackburn).

one month. Our response rate is therefore 13%.¹¹ This response rate is within the normal range for (detailed) unsolicited email surveys (Sauermann & Roach, 2013).

The main advantage of the sampling approach employed is that the vast majority of publishing UK academics (as reported in WoS) are likely to be included in the population frame from which the stratified sample is drawn. The main limitation of this approach is, however, that it may introduce *non-coverage* bias by focussing on researchers with journal-based publications. For example, academics in the performing arts and humanities are less likely to be represented in the data. Also, academics publishing from a hospital address were excluded from the survey, although biomedical researchers with university-hospital e-mail addresses would be captured in the sample as such researchers work in an HEI.

Our sampling strategy was not aimed at capturing the views of PhD candidates since these are less likely to appear as corresponding authors of publications. For this reason, we used a separate *ad-hoc* sampling approach, asking researcher survey respondents to provide contact details of PhD students (see Section “Exploring the views of PhDs and ECRs”).

C.1.2 Survey for strategic leaders

The target population includes individuals, at all HEIs, with responsibility for managing research, from individual research centre level to the highest level of senior management. Under guidance from HEFCE, a sample of 15 out of 164 HEIs was drawn. This sample attempts to ensure representative coverage of HEIs by region, size, and specialisation. The selected HEIs are: Aston University, Cardiff University, Harper Adams University, Royal Veterinary College, University College London, University for the Creative Arts, University of Bristol, University of Edinburgh, University of Keele, University of Kent, University of Lincoln, University of Portsmouth, University of Sheffield, University of Stirling, and University of Ulster.

For comparative purposes, we define ‘large HEIs’ as those that submitted more than 600 FTE staff to the last UK REF and ‘medium/small HEIs’ as those that submitted 600 or fewer FTEs to the REF.

The frame population was developed on the basis of the contact details for the entire hierarchy of research management in the 15 selected organisations – the e-mail addresses of strategic leaders were gathered directly from the HEIs’ websites in the days before the survey was sent out. These lists were sent for inspection by senior members of the HEIs’ research services before invitation e-mails were sent out to the surveyed population. We received corrected lists and/or support to deploy the survey from 13/15 (87%) HEIs in our sample. The survey was, however, deployed to all 15 HEIs in our sample to a total of 1,080 strategic leaders. Responses were sent by respondents directly to the research team.

The average response rate per HEI was 34% (367 responses were collected). There were large variations in the response rate between HEIs, ranging from 9% to 54% (standard

¹¹ It is worth noting that the response rate is 39% when emails that were opened by recipients are considered and about 78% when considering surveys that were started. This information was provided by Qualtrics, the platform used to deploy the three surveys.

deviation 10%). Our analyses accounts for these variations in the response rates by introducing non-response weights.

The main advantage of this sampling approach is that strategic leaders across different management roles are equally likely to be invited to join the survey and the e-mail addresses used were more likely to be up to date. However, given the relatively diverse nature of UK HEIs, it is difficult to represent this diversity with a subsample of 15 HEIs – i.e. the balance of specialist versus comprehensive HEIs or large versus small HEIs, and so on. This limitation has to be taken into account when interpreting the results of the analysis.

C.1.3 Survey for funders

The target population for the funders' survey was staff working at UK-based funding bodies directly involved in the distribution of funding to HEIs. No comprehensive directory of funders was available. A frame population of 741 unique organisations was established by gathering all funding calls posted by UK-based organisations on Research Professional in the 365 days to May 10th.¹² This excludes Research Councils UK and the four UK funding bodies, for which a list of 118 contacts of research managers was gathered with the support of HEFCE.¹³

To ensure that only organisations providing substantial research funding to HEIs are included in our frame population, we excluded from the sample any funder that issued fewer than three funding calls or that only offered sums of less than £1000. The remaining organisations (448) were further scrutinised to exclude funders without a major focus on the funding of research. This resulted in a list of 421 funders and 844 unique e-mail addresses. The funders' frame population is heterogeneous, including dedicated funding agencies established by government as well as charities, foundations, and professional societies.

The response rate of research managers within RCUK and the UK funding bodies was 23% (27 responses out of 118 contacts). We collected 67 responses from research managers in other funding organisations.

The advantage of the above approach is that a wide range of funders have been identified with limited expectation of bias against funders focussed on any given field of research. Nonetheless, the size of the target population is unknown. It was not possible to obtain named contacts at all organisations to build a frame population. RCUK and the HE funding bodies supplied more full contact details than other funders. Where survey invitations would only be sent to general contact details of funders, it was necessary to make the survey accessible to forwarded contacts within the target organisation (a link that is open to all,

¹² Contacts in government departments (e.g. Department for Transport) were not included in the survey.

¹³ The sample included strategy and development managers and portfolio managers as provided by AHRC; all research programme managers at BBSRC (as available on the BBSRC website); all portfolio managers and senior portfolio managers at EPSRC (as available on the EPSRC website); all team heads as provided by ESRC; all research programme managers at MRC (as available on the MRC website) that opted in to the survey; all research programme managers as provided by NERC; a sample of respondents at STFC; and nominated respondent(s) at the UK funding bodies (i.e. HEFCE, Higher Education Funding Council for Wales, Scottish Funding Council, and Department for Employment and Learning, Northern Ireland).

rather than one limited only to the recipient e-mail account). Therefore, the number of individuals obtaining an invitation to the survey (directly or indirectly) was unknown (given that respondents were not asked to divulge their employers' name, to ensure they felt comfortable sharing their views).

Table 5 Surveys for researchers, HEIs, and funders

| Survey | Researchers | Strategic leaders | Funders | |
|----------------------------------|--|--|--|-----------------------------|
| Frame population | Corresponding authors of publications published from 2013 to 2015 and based in UK HEIs | Individuals at all UK HEIs with responsibility for managing research | Staff working at UK-based funding bodies involved in the allocation of funding to HEIs | |
| Frame population email addresses | 105,839 | - | <i>RCUK and funding bodies</i> 118 | <i>Other funders</i> 844 |
| Sample email addresses | 16,625 | 1,080 (based on a sample of 15 HEIs) | 118 | 844 (from 421 funders) |
| Responses | 2,183 | 367 | 27 | 67 |
| Response rate | 13.1% | 34.0% | 22.9% | - |

Source: Authors' elaboration

With research funding strongly concentrated in government funding bodies and with staff from these groups better represented in the sample population, the results are likely to better represent the views of those working with the larger funders – hence the results from smaller funders are separately categorised.

A summary of population frame, sample, and response rate of the three surveys is reported in Table 5.

C.2 Survey for researchers

C.2.1 Descriptive statistics of the responses from researchers

The data collection for the researcher survey was completed in May 2016. The response rate was 13% (2,183 responses out of 16,625 working e-mail addresses) – this is in line with previous research using online surveys (Sauermann & Roach, 2013). The research method used captured the views of only a relatively small number of PhD candidates (i.e. 4% or 83 responses) and individuals in non-academic positions (i.e. 1% or 27 responses). Data from PhD respondents are analysed separately – see Section “Exploring the views of PhDs and ECRs”.

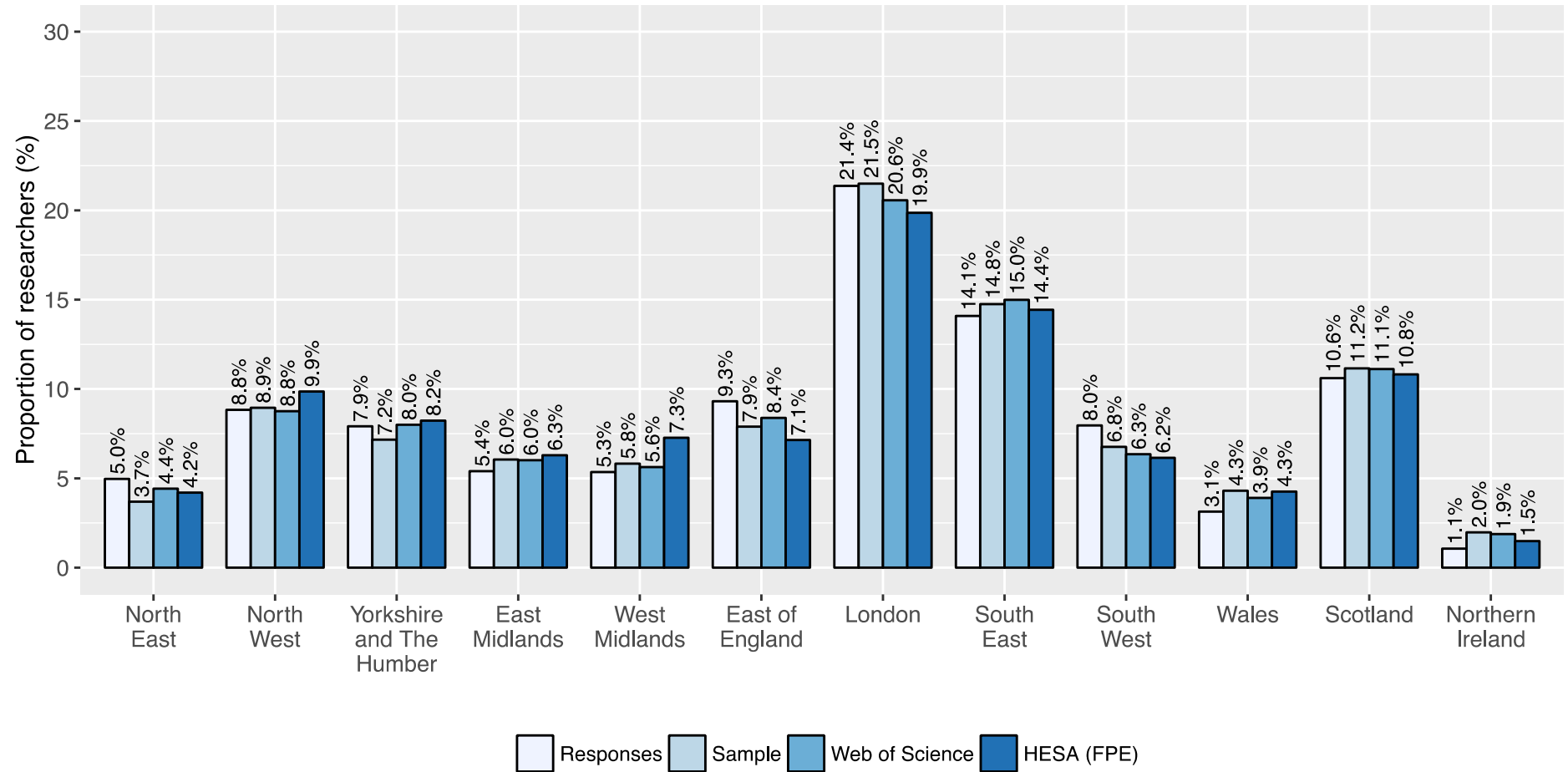
The final dataset included 2,073 responses from researchers based in UK HEIs. We explore below the dataset of responses in terms of geographical distribution, job titles, gender, and research areas and, when possible, compare these data with HESA population data in FPE based on academic staff with contracts that are for (i) 'research only' and (ii) 'research and teaching' activities. As discussed in the Methodology section, these two categories are the most appropriate considering that the survey is focussed on capturing the view of academics involved with research activities. In this regard, the survey returned only a small proportion (0.6%) of respondents in teaching-only positions (i.e. Teaching Fellows and Senior Teaching Fellows).

First, we compare the proportion of responses in each geographical UK region (NUTS-1) with the proportion of researchers in these regions according to the original sample of e-mails to which the survey was deployed, the WoS data, and the HESA data (see *Figure 3*). Differences among these groups are relatively small: from -1.2% to 1.4% when responses are compared with the sample of e-mails (researchers) to which we submitted the survey; from -0.9% to 1.6% when responses are compared with data from WoS; and from -1.9% to 2.2% when responses are compared with data from HESA. Our dataset of responses includes a larger proportion of researchers based in HEIs from the East of England, South West of England, and London when compared with HESA data; while researchers in HEIs in West Midlands, Wales, and North West are relatively less represented in the dataset of responses.

These differences might be due to different coverage of WoS data (perhaps due to different disciplinary specialisation of regions) as well as to a different propensity of researchers in different regions to respond to the survey (e.g. the 'HEFCE tag' on the survey may have reduced the propensity of researchers outside England to complete the survey).

The analysis in this report corrects for 'regional' differences between the respondents and HESA population data by introducing *base weights* (i.e., number of researchers in each region according to the HESA data out of the number of researchers in each region included in the sample of 16,625 researchers) and *non-response weights* (i.e., the reciprocal of the response rate of each region) (De Leeuw et al., 2008; Heeringa et al., 2010).

Figure 3 Researchers by region (NUTS-1)

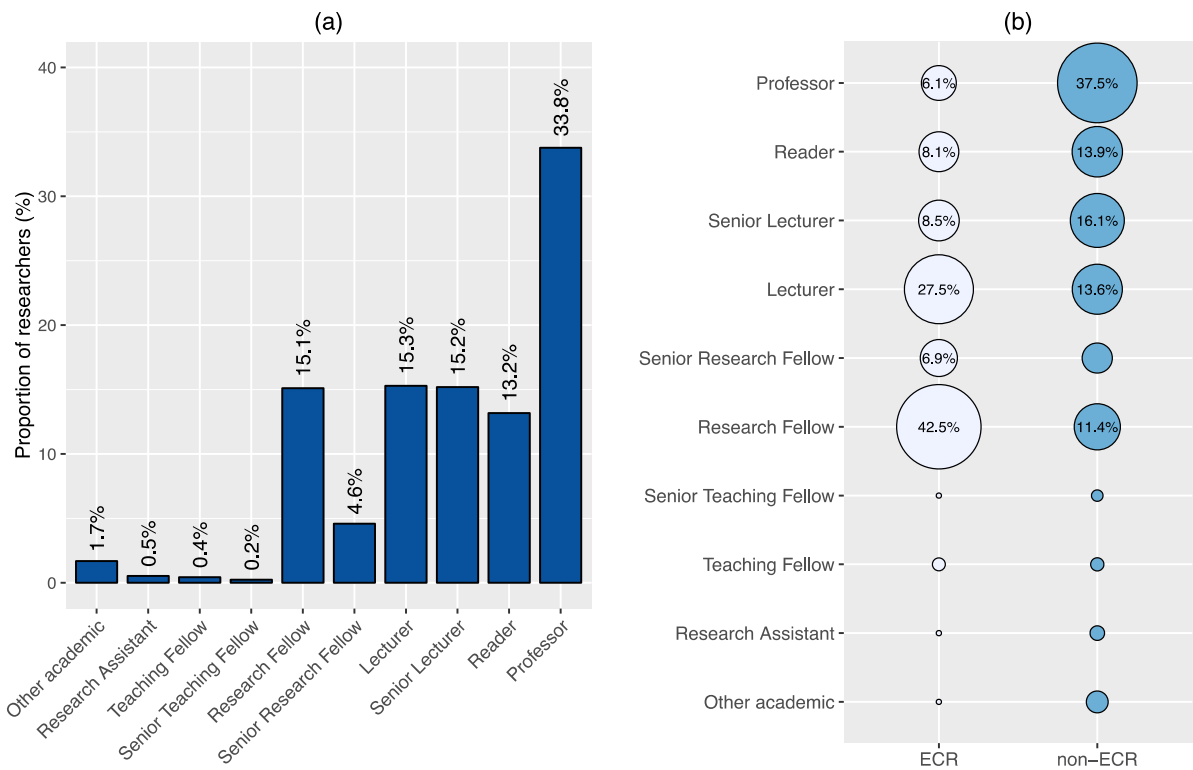


Second, we examine the job titles of respondents. These are reported in *Figure 4a*. Some of the job titles were aggregated in order to produce the figure and further grouped in

Figure 5 to map onto aggregate HESA population categories. In this regard, the comparison between respondents' job titles and the population-level HESA data indicates that researchers in professorial positions were more likely to complete the survey: 34% of the respondents are in professorial positions (*Figure 4a*). To adjust for this and ensure that each group of researchers is appropriately represented in the analysis (

Figure 5) we introduced *post-stratification weights* for contract levels. (We also introduced *post-stratification weights* for gender, as discussed below.)

Figure 4 Responses by job title (a) and ECRs (b) (proportions < 5% are not labelled)

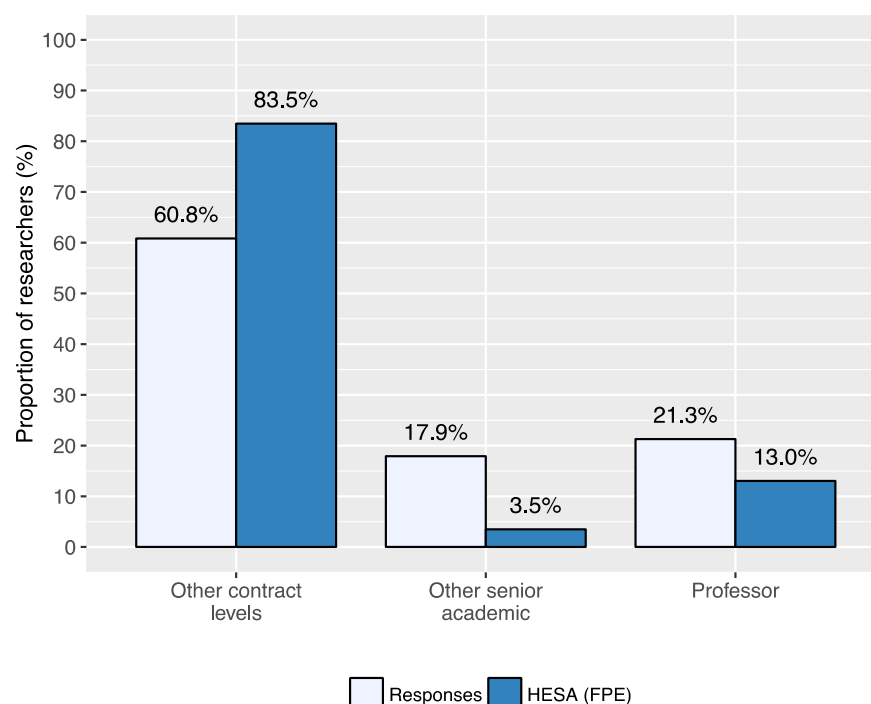


Barriers to and incentives for interdisciplinary research may be differently perceived at different points in the career of a researcher. For this reason, we identified ECRs in our dataset of responses. In line with the ECR definition used in the last REF,¹⁴ these individuals were classified as those researchers taking up their first academic post less than five years prior to the survey (i.e., after April 2011). Furthermore ECRs are defined as those having an

¹⁴ See the definition reported in the 'REF Assessment framework and guidance on submissions' at http://www.ref.ac.uk/media/ref/content/pub/assessmentframeworkandguidanceonsubmissions/GOS_including_addendum.pdf

academic post which is at least 0.2 FTE and those leading at least 50% of their research activity. Those respondents that were research assistants or held 'other academic' roles were not classified as ECRs (2.2% of respondents). Accordingly, ECRs made up 12% (247/2073) of the respondents to the survey for researchers. It is worth noting that ECRs held a wide range of job titles up to professor, indicating that a relatively large minority of ECRs (30%) are senior.

Figure 5 Responses by HESA contract levels

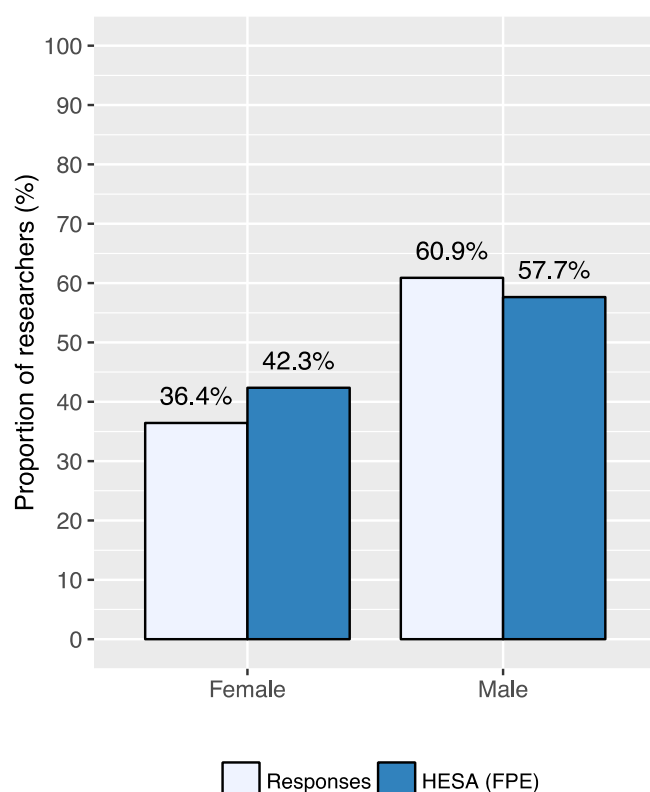


Third, we examined responses by gender. There is strong gender bias in UK academia, with females significantly underrepresented in the UK population of researchers. As reported in Figure 6, the survey responses further accentuate this bias with females less likely to be included in the dataset of respondents. Specifically, our data included 36% of responses from female researchers, against the HESA population of 42% female academics. As for contract levels, we introduced *post-stratification* weights to adjust for the overrepresentation of males in our sample.

Finally, we examined responses from researchers in terms of research areas in which they have conducted research. In order to rapidly and effectively allocate researchers to a fine-grained classification that would support further analysis of the relationships between different subject areas, the WoS subject area classification was used. This contains 251 subject categories, which are used to classify academic journals. Respondents were asked to self-classify their research areas using these subject categories. Visually displaying this many options required a series of drop down menu selections to be made by respondents – the more interdisciplinary individuals had to go through the selection cycle more times. The cumbersome nature of finding one or more relevant subject areas led to a large number of free text responses.

Once researchers had identified their subject areas they were also asked to indicate their core subject areas. 91% of respondents provided this information. For those cases where the information on core subject areas was not reported by respondents, we assumed (when available) all indicated subject areas were respondents' core subject areas. Otherwise respondents' subject areas were identified from the respondents' publications as indexed by WoS – on the basis that this provides at least some indication of the subject areas from their choice of publication channels over recent years.

Figure 6 Responses by gender



We then grouped the subject areas in research macro areas: Science, Engineering, Social Science, and Arts & Humanities. *Figure 7* depicts the number of responses by these areas. While 81% of the respondents could be exclusively classified in one of the research macro areas, 19% of the respondents indicated two or more research macro areas as their core areas. Responses from these individuals were therefore counted towards the results in both categories they self-identified with.

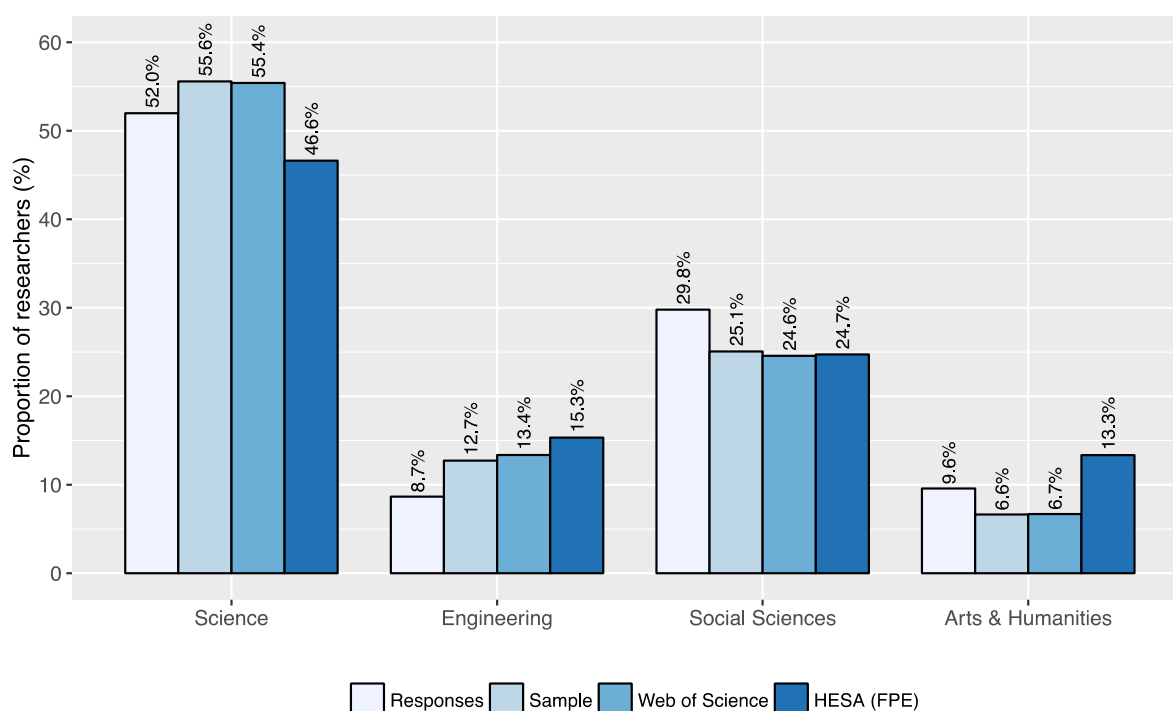
We compared our responses with data from the sample and WoS as well as with data from HESA (*Figure 7*). In the case of the sample and WoS data we could only rely on subject areas assigned to journals in which UK researchers published. In the case of HESA data our respondents were compared with information of number of academics (FPE) according to the cost-centres that they sit within at their host HEI. Cost-centres were specifically aggregated to the four research macro areas to allow the comparison. It is, however, worth

noting that the HESA data at cost-centre level have no information on the extent academics are assigned to multiple research cost-centres.

The comparison of the respondents with the sample and WoS data provides some indication that the survey has received response from a higher proportion of researchers in Social Sciences and Arts & Humanities and a lower proportion of researchers in Science and Engineering as compared to those identified in WoS data. However, when responses are compared with HESA data, the proportion of researchers in Engineering and Arts & Humanities is lower than the proportion of researchers assigned to cost centres in these areas according to HESA data.

The researchers responding to the survey cannot be exclusively assigned to one research area only (especially in the case of interdisciplinary researchers). The lack of granularity in the population statistics available for comparison with the dataset of responses meant that we deemed it more suitable not to introduce *post-stratification weights* to correct for differences in the proportion of academics responding by research areas. Instead, views on the barriers to, and incentives for, interdisciplinarity are reported according to the views from researchers in four research macro areas separately: Science, Engineering, Social Science, and Arts & Humanities.

Figure 7 Responses by research macro areas



C.2.2 Results

In the next sections we analyse the responses from researchers across the four research macro areas – Science, Engineering, Social Science, Arts & Humanities (A&H) – in terms of perceived importance of IDR, involvement with IDR activities, perceived and experienced barriers to and incentives for IDR.

It is worth noting that all proportions (and statistical tests) reported in the analyses below are adjusted by the three different types of weights discussed above: *base* and *non-response rate* weights by region and *post-stratification weight* defined on the basis of contract levels-gender combinations.

The vast majority of respondents across the four research macro areas (ranging from 84% to 88%) consider IDR as being extremely important or very important (*Figure 8a*). However, this has to be seen in the context that at least 87% of respondents had undertaken IDR at some point, mostly within the last three years. A&H researchers appear to be most likely to be engaged in IDR (see *Figure 8b*).

Of those that have not undertaken IDR within the last three years, 49% to 55% of researchers across the research macro areas are not sure whether they will undertake IDR in the future; 24% to 25% are not considering undertaking IDR in the future, while between 21% and 27% are considering undertaking IDR (see *Figure 8c*).

We also explored the extent to which individuals that have been involved with IDR (within the last three years or in the past, but not at present) are likely to place more importance on IDR than respondents that were not involved with IDR or that reported 'I do not know' (*Figure 9*). These findings were tested with an ordered logit regression model of the declared importance of IDR against involvement with IDR. The results indicate that in all research macro areas, respondents that have been involved with IDR within the last three years are more likely ($p < 0.01$) to place the importance of IDR in the higher categories of the scale than respondents that were not involved with IDR or that reported 'I do not know'. It is important to note that across the four research macro areas the majority of respondents who had not undertaken IDR still suggested that IDR was at least moderately important. Indeed, in Social Science and Engineering the majority of researchers that had not undertaken IDR suggested IDR was very or extremely important.

Importance of and involvement with IDR

Figure 8 Importance of IDR (a), involvement with IDR (b), and planning to undertake IDR (c) (proportions <5% are not labelled)

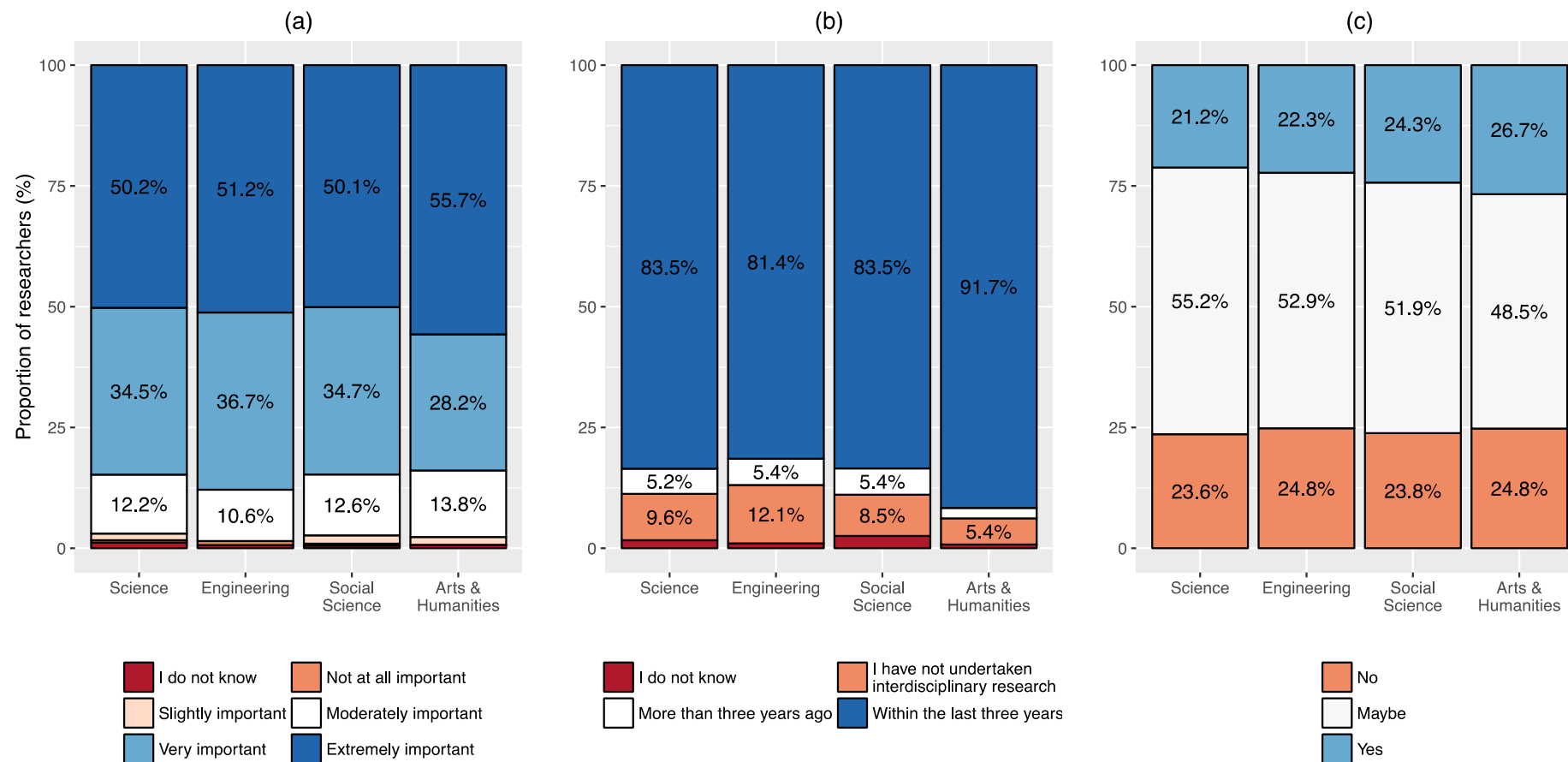
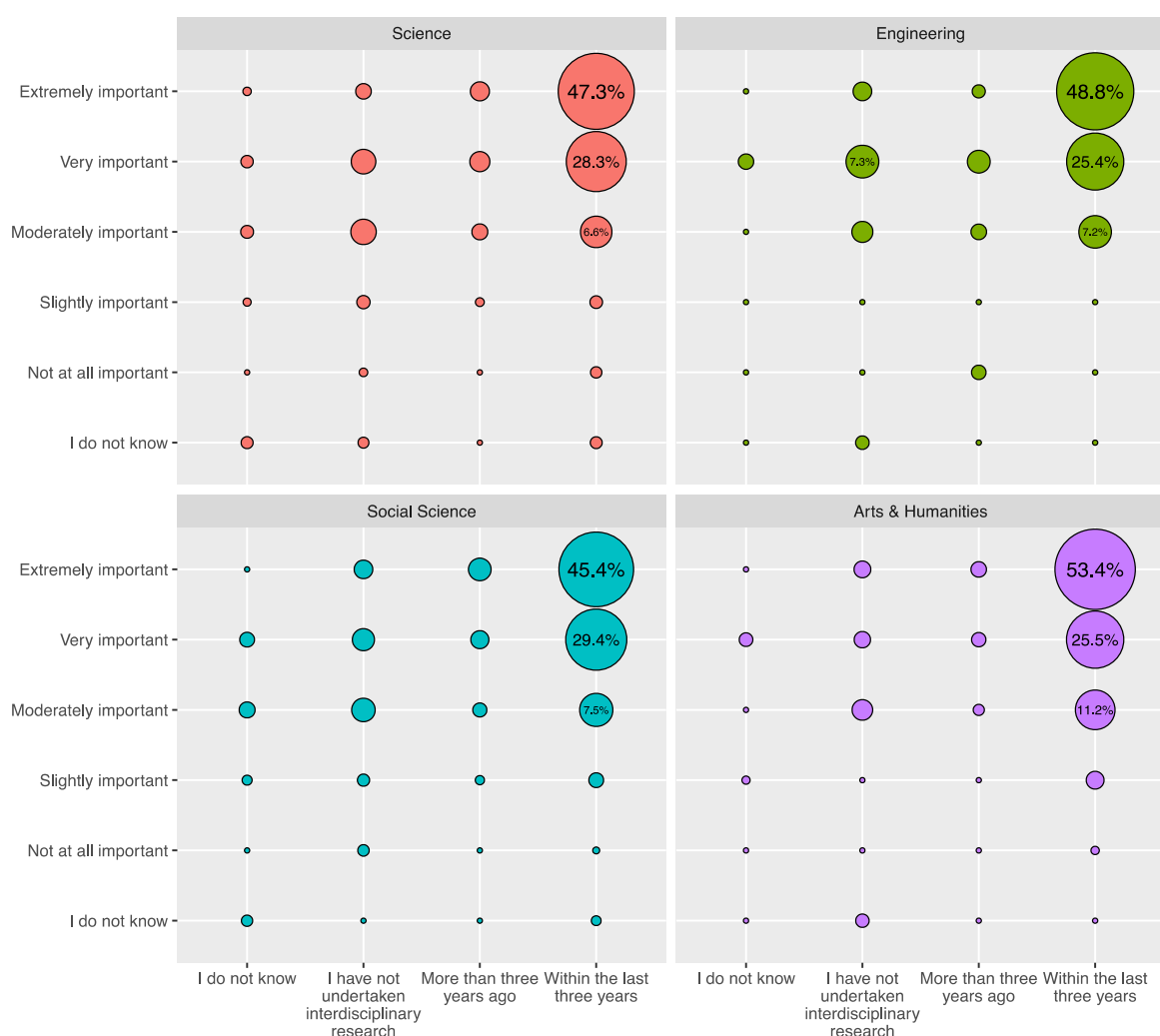


Figure 9 Involvement with and importance of IDR across research macro areas (proportions <5% are not labelled)



Perceived barriers to IDR

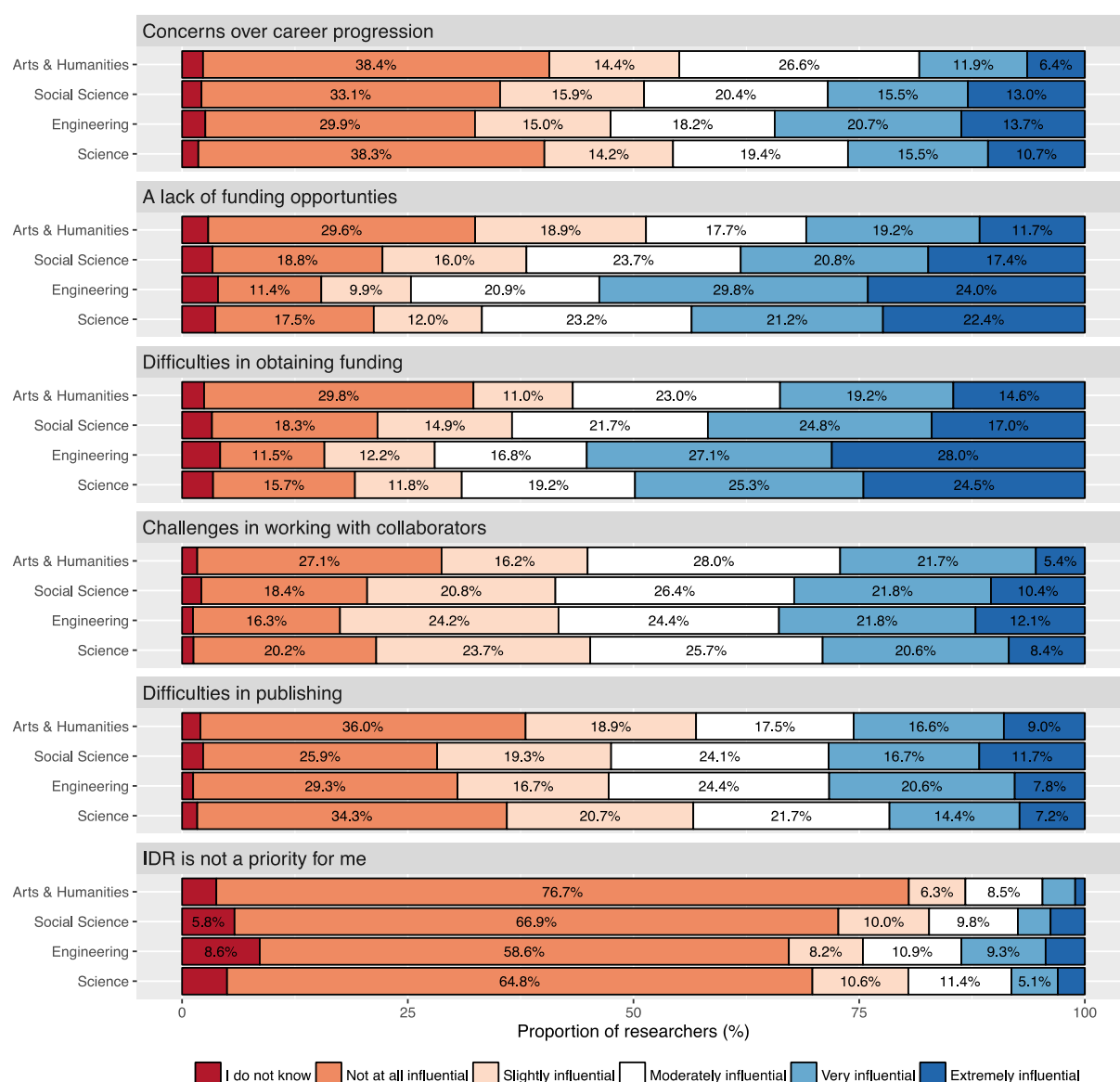
There are important differences in the perception of barriers to IDR across the research macro areas (*Figure 10*), with the biggest contrast seen between A&H and Engineering. Across the board, researchers in Engineering seem to be more influenced by barriers to IDR than A&H.

Results from researchers in A&H seem to indicate that they are the least influenced by any consequences of IDR on their career progression when compared to researchers in Engineering and Social Sciences (*K-W test on distributions: $p < 0.05$*), while researchers in Science are less influenced by concerns over career progression than researchers in Engineering (*K-W test on distributions: $p < 0.05$*).

54% of researchers in Engineering see the lack of funding opportunities as a very or extremely influential barrier compared to 31% of researchers in A&H (*K-W test on distributions: $p < 0.001$*), 44% of researchers in Science (*K-W test on distributions: $p < 0.05$*), and 38% of researchers in Social Sciences (*K-W test on distributions: $p < 0.001$*). A&H

researchers appear to be the least influenced by this barrier (*K-W test on distributions: $p < 0.01$*): 30% of researchers in A&H consider ‘a lack of funding opportunities’ not at all influential. Scientists are more influenced by this barrier than Social Scientists (*K-W test on distributions: $p < 0.05$*). Researchers in Science and Engineering perceived the barrier ‘difficulties in obtaining funding’ as more influential than researchers in Social Sciences and A&H (*K-W test on distributions: $p < 0.001$*) – 58% of researchers in Social Sciences and 64% of researchers in A&H consider ‘difficulties in obtaining funding’ as ‘not at all influential’ or ‘moderately influential’.

Figure 10 Perceived barriers to IDR by research area (proportions <5% are not labelled)



27% to 34% of respondents across the four research macro areas indicated that the challenge of working with collaborators for IDR was a very or extremely influential perceived barrier. There were no statistical differences across the research macro areas.

Difficulties in publishing were considered very or extremely influential by researchers in Engineering and Social Science to much the same extent (28% of respondents), while those in A&H and Science were less influenced by difficulties in publishing (26% and 22% of respondents respectively). Social Science researchers were more concerned about difficulties in publishing than researchers in Science (*K-W test on distributions: $p < 0.001$*) and A&H (*K-W test on distributions: $p < 0.05$*).

Across the four areas, a large majority (59% to 77%) indicate that IDR 'not being a priority' is not influential – in other words they are committed to IDR. This is especially true in the case of researchers in A&H when compared to researchers in the other areas (*K-W test on distributions: $p < 0.05$*).

IDR and career

A large majority of respondents (68% in Science, 71% in Engineering, and 69% in A&H, but 62% in Social Sciences) thought that strong disciplinary training is an essential foundation for interdisciplinary research (*Figure 11*). Researchers in Social Science were very slightly more likely to disagree or strongly disagree (34%) with this view than other researchers (26% to 28% of respondents) (*K-W test on distributions: $p < 0.05$*).

Social scientists were also least likely to agree or strongly agree that IDR required a considerable amount of additional training (50%). Social Science researchers were more likely to hold a neutral view too; a minority of 24% disagreed or strongly disagreed that considerable time for training was needed. Researchers in Engineering in contrast were more likely to agree or strongly agree (66%) that this was a barrier. Differences between the distributions of the responses were significant (*K-W test on distributions: $p < 0.05$*).

Social Science and A&H researchers were least likely to strongly agree or agree that job opportunities were better for interdisciplinary researchers (23% for both groups) compared to researchers in Engineering (44%) and Science (38%) who strongly agreed or agreed (*K-W test on distributions: $p < 0.001$*).

Researchers generally were more likely to agree that peers in their core disciplines would consider IDR less rigorous. This was more finely balanced in Science, and most pronounced in A&H (*K-W test on distributions: $p < 0.001$*). A&H researchers were more than twice as likely to agree than disagree (52% versus 21%) while among researchers in Science 40% agreed and 37% disagreed.

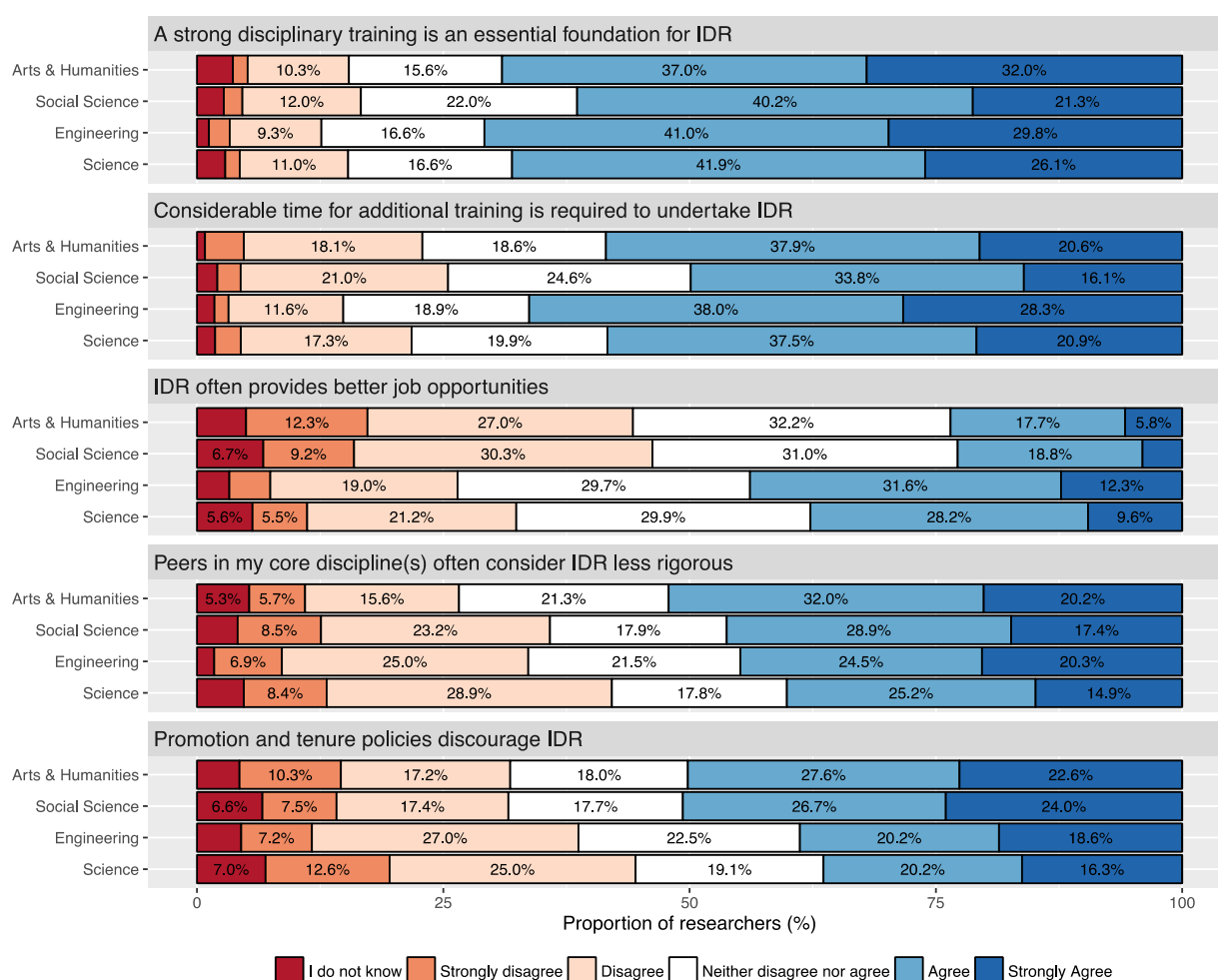
Researchers in A&H and Social Science were much more likely to strongly agree or agree that promotion and tenure policies discouraged IDR than to strongly disagree or disagree (50% against 28% and 51% against 25% respectively). Social Science researchers were significantly more likely to see promotion and tenure policies as a barrier than researchers in Science and Engineering (*K-W test on distributions: $p < 0.01$*). Sentiment amongst Scientists and Engineers was more finely balanced, with no clear overall agreement/disagreement.

In response to these statements, 284 researchers made qualitative comments. Although the comments were diverse in content, a number of themes can be observed. The first theme that emerged was one of peer-review, focussing on the peer review processes involved in funding applications ($n=14$), publishing ($n=18$), and academic promotions ($n=54$). This is exemplified by one quote from the comments: "Interdisciplinary research is encouraged at a

surface level, it promotes more critical engagement with societal issues, but is not then rewarded in terms of funding opportunities, publishing, or career progression”.

Other themes included issues related to finding partners, finding a common language, and finding mutual understanding in collaborations; the structures built around disciplines in HEIs and Research Councils themselves; as well as the increased time that interdisciplinary research takes. One researcher said simply: “in practice this kind of research takes longer to produce real outcomes”.

Figure 11 IDR and careers by research area (proportions <5% are not labelled)



IDR and funding

We explored whether researchers across the four research macro areas perceived IDR as more or less likely to be funded compared to monodisciplinary research.

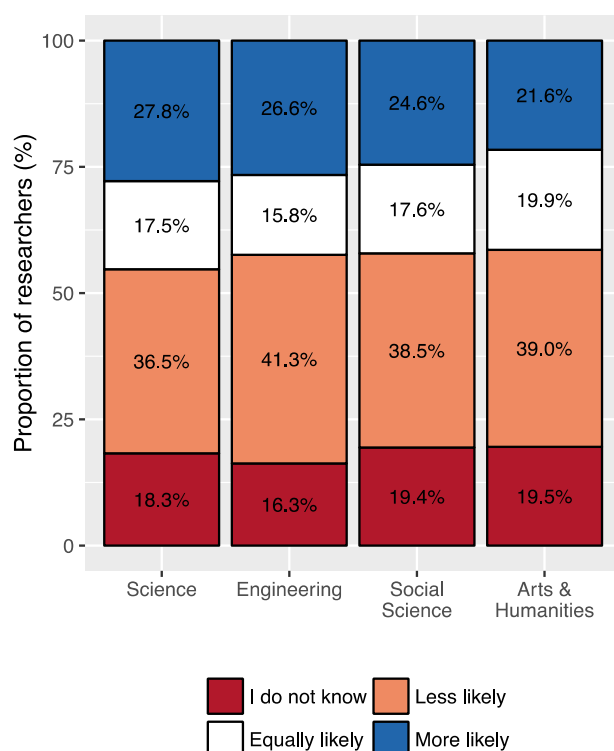
Figure 12 shows that many more researchers felt that IDR was less likely, rather than more likely, to be funded: 830 respondents considered IDR less likely to be funded, while 518 and 370 respondents considered it more likely and equally likely to be funded respectively. Across the research macro areas 37% to 41% of respondents considered IDR less likely to be funded compared to between 22% and 28% that thought that IDR was more likely to be

funded. 16% to 20% thought IDR was equally likely to be funded. There were no significant differences in the views from the different research macro areas.

Survey respondents from all research areas, who agreed that IDR was less likely to be funded, were in agreement on the issue of monodisciplinary reviewers of funding applications (*Figure 13*). We found no statistically significant differences across research areas except when comparing Science with Social Science. The vast majority (between 86%-90%) suggested this was a very influential or extremely influential factor with a majority suggesting this was an extremely influential factor. Less than 1% in each research area felt that the monodisciplinary perspective of reviewers was not at all influential.

One respondent [a Senior Lecturer in the Social Sciences] put the challenge clearly in a free text response: “Funders try to support interdisciplinary research but have not yet evolved an appropriate peer review infrastructure to support [IDR]”.

Figure 12 Likelihood of IDR being funded

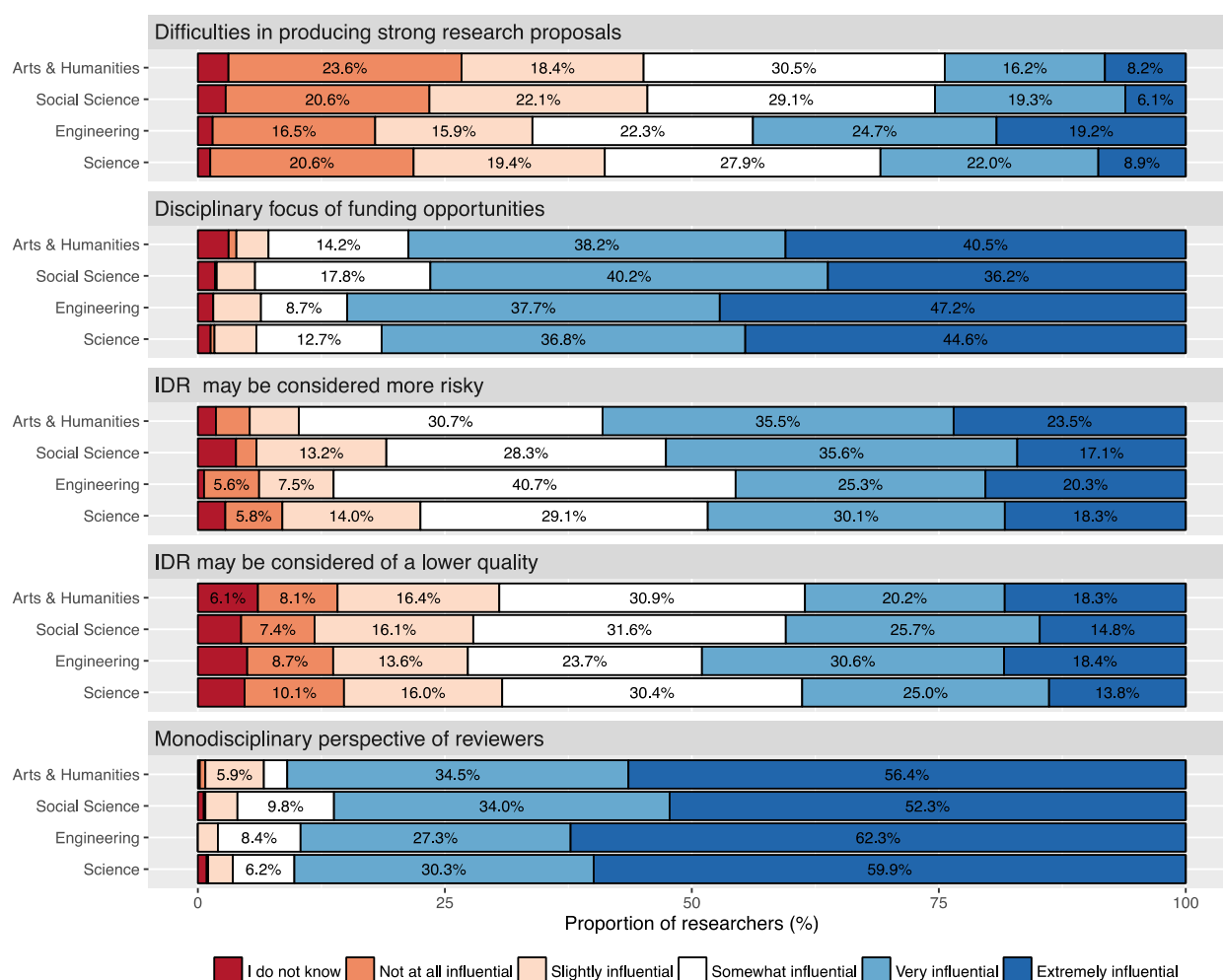


There was wide agreement (at least 76% of researchers in each research macro area) that the disciplinary focus of funding opportunities was an extremely influential or very influential factor – we found no statistically significant differences across research areas. In all areas except for Social Science, this was thought most often to be extremely influential rather than very influential.

The vast majority (over 90%) of researchers in all areas thought that IDR funding proposals would be considered more risky and that this would be influential to some extent. Science and Engineering had the highest proportions of respondents that saw this factor as not at all influential (6% for both). A&H researchers, followed by Social Science researchers, were most likely to think that increased riskiness would be extremely influential or very influential

in the fate of IDR funding attempts (59% for A&H and 53% for Social Science) compared to researchers in Science and Engineering (48% and 46% respectively). In this regard, we found a statistically significant difference between the distributions of opinions of researchers in Science and A&H (K-W test on distributions: $p < 0.05$).

Figure 13 Reasons why IDR is perceived as less likely to be funded (proportions <5% are not labelled)



The vast majority of researchers (over 85%) in all areas thought that IDR funding proposals would be considered of lower quality and that this would be influential to some extent – we found no statistically significant differences across research macro areas. More than any other group, researchers in Engineering saw this as an ‘extremely’ or ‘very’ influential factor (49%).

The vast majority of researchers (between 73% and 82%) in all areas saw difficulties in producing strong research proposals as at least a slightly influential factor in making IDR less likely to be funded. Researchers in Engineering found this factor to be more influential (82%) compared to other research macro areas (K-W test on distributions: $p < 0.05$). A&H researchers were most likely to see this factor as not at all influential (24%) and engineers were least likely (17%).

Free text comments were made by 153 researchers with reference to the aforementioned perceived barriers to IDR funding. The majority of comments in this section focussed on two issues. The first was the peer review process involved in evaluating the contribution, methods, value, robustness, or rigour of the proposed study (n=92). In many cases (n=80), the expertise of the reviewers was criticised for being overly disciplinary, in others it was stated that a single negative view (given by an overly disciplinary reviewer) can block a proposal. Secondly, the very structures of the Research Councils were noted as barriers to IDR (n=23). Some of these respondents suggested that IDR can 'fall between the cracks' of two different councils (or in some cases between two review panels within a council).

Across all research macro areas few researchers (between 8% and 15%) thought that lower competition for IDR proposals was an influential factor explaining higher likelihood of IDR proposals being funded. The statistical analysis did not reveal any significant differences across areas. However, Social Science and A&H researchers more frequently saw the potential for lower competition as 'not at all influential' (37% and 34% respectively compared to 26% and 17% for researchers in Science and Engineering respectively).

Relatively few respondents made qualitative comments regarding this factor (n=26). However, this group seemed to be more cautious of IDR. One researcher noted that funders "believe somehow that the synthesis of fields will generate new insight. It may, but equally may not." Other comments described complex, societal questions requiring interdisciplinary perspectives and peer review infrastructure as a perceived barrier.

Figure 14 explores the possible reasons why the smaller number of researchers who thought that IDR was more likely to be funded took this view. There was almost universal acknowledgement of at least some slight influence coming from the increasing focus of funders on supporting IDR – we found no statistically significant differences among the distributions of responses across research macro areas (*K-W test on distributions: $p>0.05$*). In all research macro areas, researchers (ranging from 70% of respondents for Engineering to 83% for A&H) indicated increased funder support for IDR as extremely influential or very influential.

Furthermore, the majority of respondents (ranging from 56% in Engineering to 64% in Social Science) saw access to larger funding opportunities as extremely or very influential in increasing the likelihood of funding IDR – we found no statistically significant differences among the distributions of responses across research macro areas (*K-W test on distributions: $p>0.05$*).

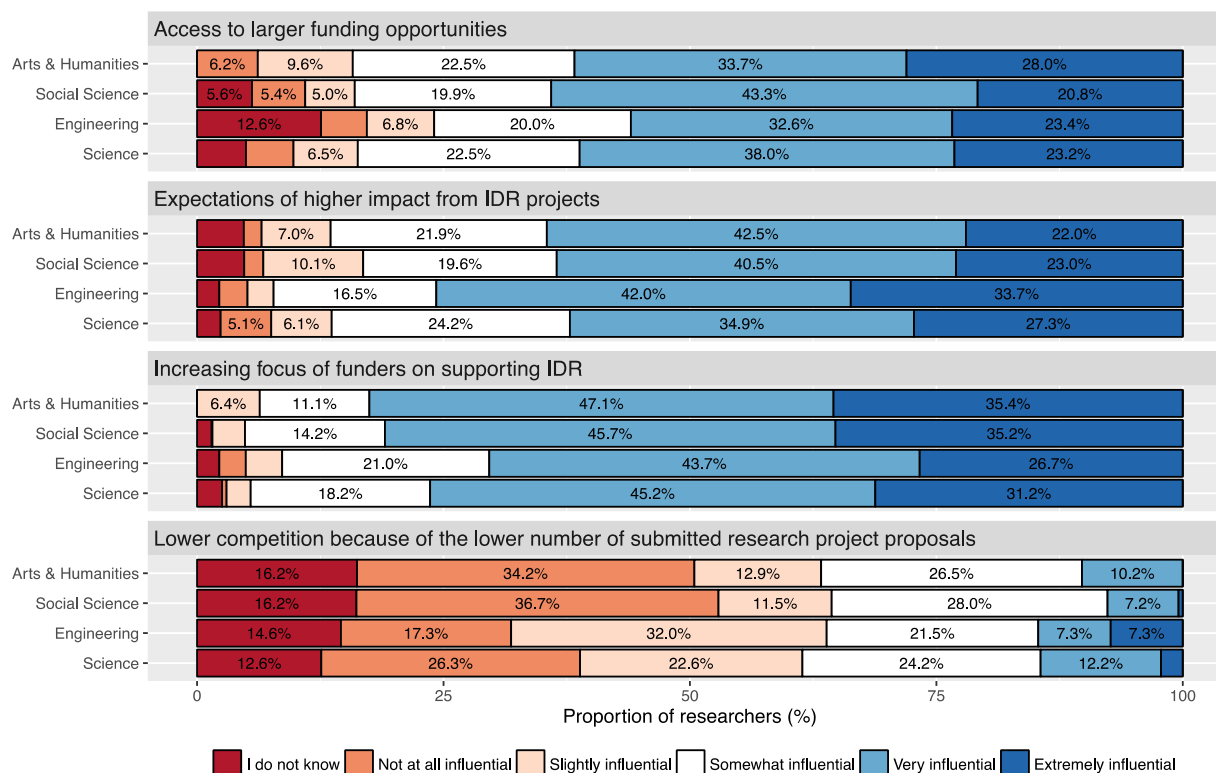
There was even stronger belief that funders' expectations of higher impact from IDR projects are extremely or very influential in their better funding prospects (ranging from 62% for scientists to 76% for engineers) – we found no statistically significant differences among the distributions of responses across research macro areas (*K-W test on distributions: $p>0.05$*).

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Relatively few respondents made qualitative comments regarding this factor (n=26). However, this group seemed to be more cautious of IDR. One researcher noted that funders "believe somehow that the synthesis of fields will generate new insight. It may, but equally

may not.” Other comments described complex, societal questions requiring interdisciplinary perspectives and peer review infrastructure as a perceived barrier.

Figure 14 IDR perceived as more likely to be funded (proportions <5% are not labelled)

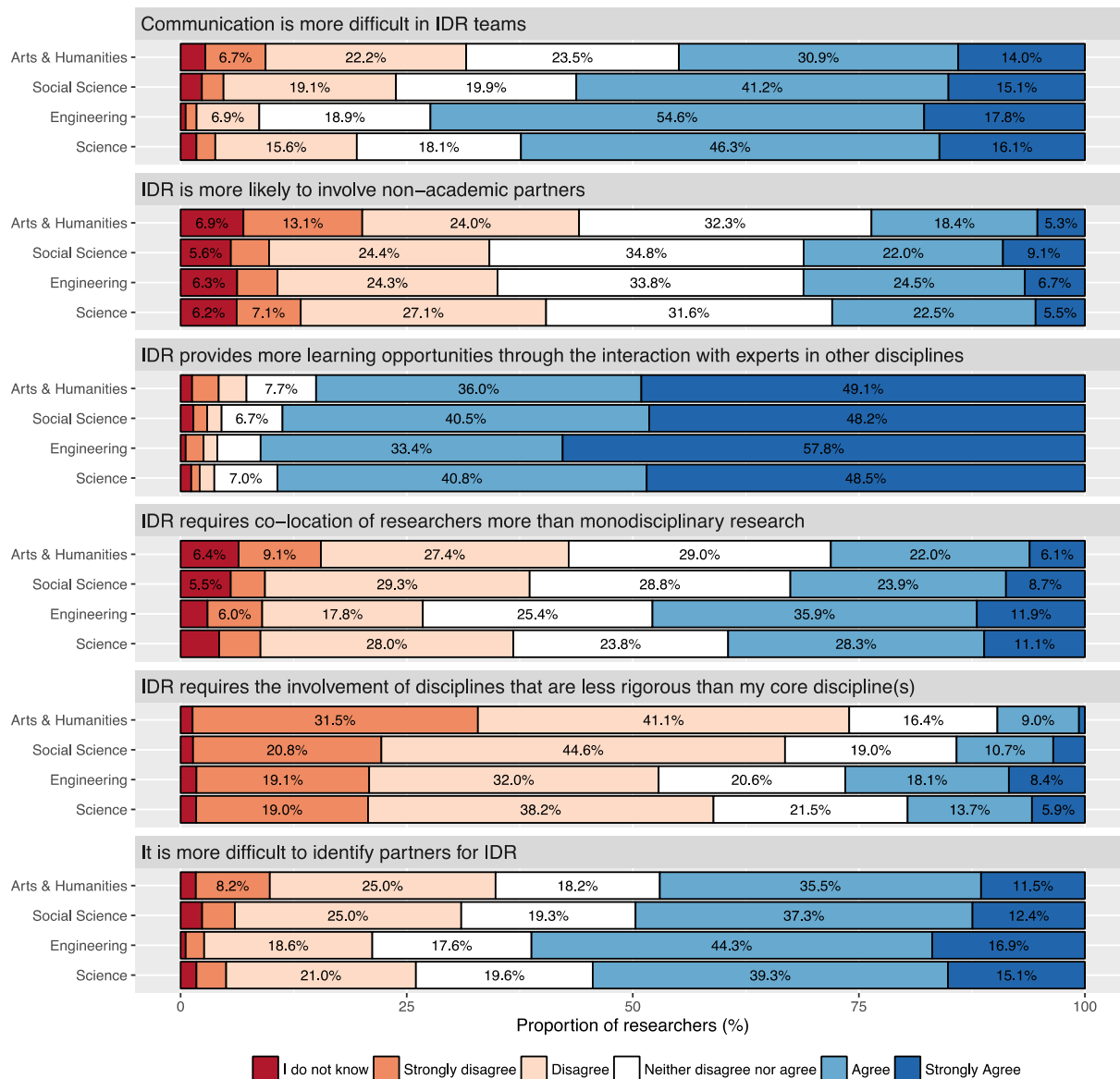


IDR and collaboration

The consideration of IDR collaboration elicited mixed responses with some general agreement across disciplines and disparities in other aspects (*Figure 15*). On the question of whether it was more difficult to find partners for IDR, A&H researchers and social scientists tended to agree or disagree in similar proportions, with stronger agreement (47% for A&H and 50% for Social Science) than disagreement (30%). Researchers in Science and Engineering showed greater agreement than researchers in Social Science and A&H (*K-W test on distributions: $p < 0.05$*), with researchers in Engineering most frequently agreeing that finding partners was more difficult for IDR (61% strongly agreed or agreed with the statement).

A very pronounced set of results was prompted by the statement that communication was more difficult in IDR teams. A&H researchers were least likely to strongly agree or agree with this proposition (45%), followed by Social Science (56%) and Science (62%) researchers. Finally, researchers in Engineering felt significantly more strongly than other research macro areas that team communication in IDR was more difficult with 72% suggesting they agree or strongly agree with the proposition (*K-W test on distributions: $p < 0.05$*).

Figure 15 IDR and collaboration (proportions <5% are not labelled)



The results for whether IDR required co-location very closely mirrored those regarding the difficulty of communication in IDR teams. Researchers in Engineering were nearly twice as likely to favour co-location very strongly (12%) compared to those in A&H (6%). Overall A&H researchers strongly agreed or agreed with the need of colocation for IDR in 28% of cases compared to the much higher levels of agreement (48%) from researchers in Engineering. The Social Science researchers agreed or strongly agreed in 33% of cases as did 39% of Science researchers (*K-W test on distributions: $p < 0.05$*).

Respondents were asked whether they agreed with the statement that IDR involved collaborating with less rigorous disciplines. In each macro research area they disagreed with the statement. A&H researchers most often disagreed (73%), and much more strongly than researchers in the other three research areas. Social Science researchers followed a similar

pattern but with less strong disagreement (65%), followed by those in Science (57%) and finally Engineering researchers, where 51% of Engineering researchers disagreed or strongly disagreed with the statement. Although the Engineering researchers were most concerned that IDR would require working with less rigorous disciplines, only 27% of Engineering respondents thought along these lines. Differences among the distributions of responses across research macro areas were statistically significant (*K-W test on distributions: $p < 0.05$*).

Differences were stronger within research areas than across them on the question of whether or not IDR was more likely to involve non-academic partners. More A&H and Science researchers disagreed or strongly disagreed with this proposition than agreed or strongly agreed. In Engineering and Social Science these positions were reversed, with a third of researchers agreeing or strongly agreeing. A large sub-set of respondents (ranging from 32% to 35%) neither agreed nor disagreed. Overall A&H researchers showed significantly less agreement with the statement than researchers in Engineering and Social Science (*K-W test on distributions: $p < 0.05$*).

Very few respondents across each of the four research areas disagreed with the proposition that IDR provided more learning opportunities. The largest gap in agreement was between A&H and Engineering researchers who strongly agreed or agreed with the proposition in 85% and 91% of cases respectively. Engineering researchers strongly agreed more often (58%), which was 10% more than researchers in the other three areas – differences among the distributions of responses were significant (*K-W test on distributions: $p < 0.05$*).

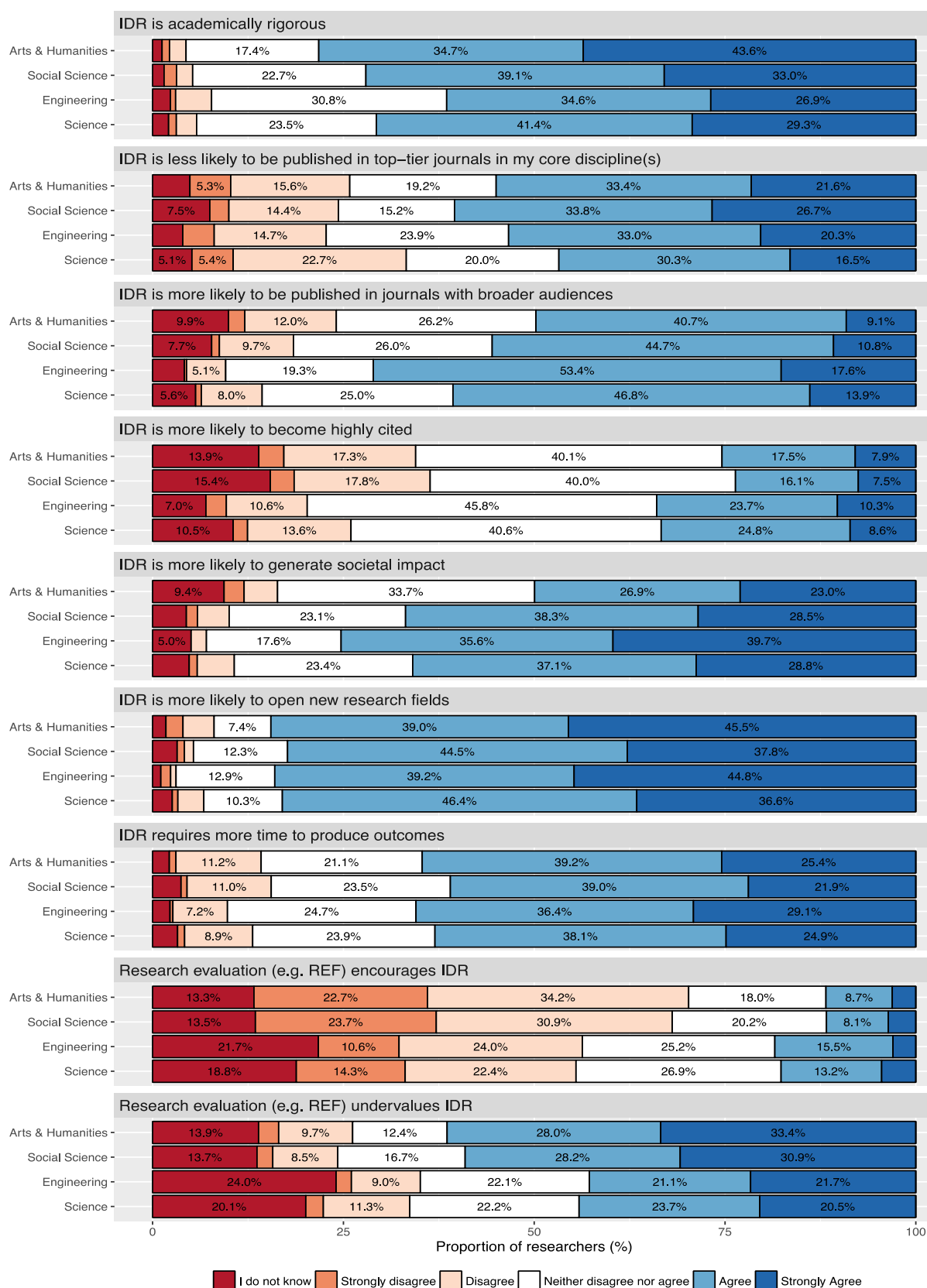
Of the 111 researchers providing free text answers in this section many noted that all of the above factors varied highly from project to project with some noting that IDR is not necessarily different to disciplinary research in these respects. One researcher noted that “since each interdisciplinary group is particular... the answer depends on which one you’re referring to”. However, two common themes were that communication ($n=14$) and collaboration generally ($n=14$) were difficult in IDR.

IDR and outcomes

We explore barriers to and incentives for IDR in terms of research outcomes in *Figure 16*. A majority of respondents (62% to 79%) across the four research macro areas, agreed or strongly agreed that IDR is academically rigorous. A&H researchers were significantly more likely to support the proposition (79%) than researchers in other areas (*K-W test on distributions: $p < 0.05$*). Researchers in Science and Social Science supported the proposition in 71% and 72% of cases respectively, while researchers in Engineering agreed or strongly agreed significantly less often (62%) (*K-W test on distributions: $p < 0.05$*).

The picture is very different when it comes to publishing in top tier journals. Social Science researchers agree or strongly agree with the proposition that IDR is more difficult to publish in these outlets (61%) more than researchers in Science and Engineering (*K-W test on distributions: $p < 0.05$*) – Social Science researchers are the least likely to hold the neutral centre ground (15% compared to between 19% and 24% of respondents from other research macro areas). The population of A&H and Engineering researchers present a similar profile (55% and 53% respectively) agreeing or strongly agreeing – their agreement is significantly higher than that of researchers in Science (*K-W test on distributions: $p < 0.05$*).

Figure 16 IDR and research outcomes (proportions <5% are not labelled)



Researchers in Science were most polarised with 46% agreeing or strongly agreeing against 28% that disagreed or strongly disagreed with the statement.

A widely perceived benefit across the four research areas was that IDR was more likely to find an outlet in a journal that reached a broader audience. More researchers in Engineering agreed or strongly agreed (71%) with this statement, followed by researchers in Science (61%), Social Science (56%), and A&H (50%). The agreement among researchers in Engineering and Science is significantly higher than among those in Social Science and A&H (*K-W test on distributions: $p < 0.05$*). However, many researchers (ranging from 19% in Engineering to 26% in A&H) held a neutral view leaving few that disagreed to any extent.

There was great uncertainty about whether or not IDR publications would attract high citations, with a neutral view held more than any other view across the research areas. 33% of researchers in Science and 34% of those in Engineering agreed or strongly agreed that IDR would be more likely to be highly cited. For A&H and Social Science researchers, the comparable figures were 25% and 24% respectively (*K-W test on distributions: $p < 0.05$*). Similarly, A&H and Social Science researchers were more likely to disagree to some extent with the proposition (20%) while less than 15% of Engineers or Scientists do so.

In terms of IDR being more likely to generate societal impact, Engineering researchers agreed or strongly agreed in 75% of cases, i.e. statistically significantly more than researchers in Science and Social Science (*K-W test on distributions: $p < 0.05$*), who had very similar views, with two thirds of both seeing IDR as more likely to generate impact. 50% of A&H researchers saw impact as being more likely from IDR but they were also the most likely to express a neutral view (34%).

The strongest agreement on IDR outcomes was that IDR was more likely to create new research fields, where we found no statistically significant difference across the research macro areas and between 81% and 85% of researchers agree or strongly agree with this statement. There was little neutrality around this consideration (between 7% and 13% across the four areas).

Researchers thought that IDR took longer to produce outcomes (there was no statistically significant difference across the research macro areas). At least 61% of researchers in all fields agreed or strongly agreed with this point. Engineering researchers agreed the most (66%), followed by A&H (65%), Science (63%), and Social Science researchers (61%). Only 8-12% of researchers disagreed or strongly disagreed across the four research areas.

The four research areas were markedly divided by the degree to which they thought that REF favoured IDR or not. The results are clear in the sense that respondents in all four research areas were much more likely to disagree (from 34% to 57%) with the statement that REF encourages IDR than agree with it (12% to 18%). Disagreement was more common in A&H and Social Science. Researchers in Science and Engineering agreed with the above statement more than researchers in Social Science and A&H (*K-W test on distributions: $p < 0.01$*), although more of them still disagreed than agreed. However, a larger share did not have an opinion or were neutral (totalling 47% for engineering and 46% for science). By contrast A&H researchers were about five times more likely to disagree than agree to some extent (57% versus 12%) and Social Science researchers were about four times more likely to disagree (54% versus 12%). Scientists were just over twice as likely to disagree than agree (37% versus 18%), while Engineering researchers were just under twice as likely, with 18% agreeing versus 34% disagreeing that the REF encourages IDR. In each research macro area there was a notable minority that did not know (13% to 22%) or were neutral (between 18% and 27%).

A statement on whether research evaluation was likely to undervalue IDR also saw significantly divergent results between Science and Engineering on the one hand and Social Science and A&H on the other (*K-W test on distributions* $p < 0.05$). In Social Sciences and A&H, the majority of researchers agreed or strongly agreed that research evaluation undervalues IDR (about 59% and 61% respectively). A large minority were neutral or did not know (ranging from 26% for A&H and 31% for Social Science up to 42% for Science and 46% for Engineering).

Free text responses were provided by 136 researchers on the above statements. Of these, 30 noted that the questions posed were broad and that academic rigour across IDR and disciplinary research is quite similar and that rigour depends on the individual case rather than generally being different across IDR and monodisciplinary research. One respondent captured the spirit of these comments well: "It is hard to generalise. I think the quality of interdisciplinary research has a similar spectrum to research done within one discipline".

The REF was an important theme drawn out in this question ($n=30$) but it appeared in all previous questions and in the 'general comments' question. Many researchers noted that they thought interdisciplinary research was unduly penalised by the REF and that this had knock-on effects on their career progression. One researcher noted "[w]e need a major change in REF metrics to address this issue but I am not hopeful that the current culture will change".

C.2.3 Exploring the views of PhD candidates and ECRs

This section explores the extent to which the views of PhD candidates and ECRs on barriers to and incentives for IDR differ from those of more established researchers.

We had anticipated that ECRs and PhD candidates would be underrepresented among the survey responders. For this reason, we asked researcher respondents to list up to five e-mail addresses of PhD candidates and ECRs who would take the survey. Respondents provided a sample of 1,801 unique e-mail addresses (although of these 29 e-mail addresses turned out not to work). The researcher survey was then sent to these email addresses.

Contrary to expectations, the survey for researchers already collected a relatively large number of responses from ECRs (247 responses, i.e. 12% of the responses collected with the original survey for researchers). To ensure that no further ECRs responded unnecessarily, when sending out the survey to collect additional PhD candidate responses, an 'opt-out' link for non-PhDs was included in the e-mail containing the link to the survey.

The additional email addresses supplied by researcher respondents allowed us to collect 175 additional responses from PhD candidates – 353 respondents started the survey but then opted out, likely because they were ECRs. The response rate can be estimated as follows. By a conservative estimate we could assume all non-responding e-mail addresses to be associated with PhD candidates. In this case the response rate is 12%. However, if we assume that non-responding email addresses are proportionally distributed across PhDs candidates and ECRs – i.e. 33% are PhD candidates and 67% are ECRs – the response rate is 37%.

These responses were combined with the 175 responses of PhD candidates collected via the original survey for researchers, i.e. 83 responses. The analysis below is therefore based on this set of 258 responses from PhD candidates.

We first analyse the views of PhD candidates on barriers to and incentives for IDR and then those of the ECR respondents replying to the original researcher survey. In both cases, we report only on meaningful or systematic differences between PhDs or ECRs and more established researchers across the four research macro areas: Arts & Humanities, Social Science, Engineering, and Science.

Results suggest that, from a career perspective, PhD candidates seem less concerned than researchers about the consequences of being involved in IDR. Between 36% and 51% of the researchers across the four research areas agreed or strongly agreed that promotion and tenure policies discourage IDR. For PhD candidates this was between 21% and 33% across the four macro areas.

PhD candidates in Science and Social Science have higher expectations than researchers in the same macro areas of the job opportunities that IDR can provide. Specifically, about 51% of PhD candidates in Science and 41% of PhD candidates in Social Science agreed or strongly agreed with the above statement against only 38% and 23%, respectively, for researchers in these macro areas. PhD candidates in these areas are also less concerned than researchers about peers considering IDR less rigorous (25% versus 40% in Science, 28% versus 46% in Social Science).

The analysis found no difference between PhD candidates and researchers on additional training being a barrier to IDR except in the case of Social Science. Here it seems that PhD candidates seem to be more concerned than researchers in the same discipline: 68% of PhD candidates against 50% of researchers in Social Science agreed or strongly agreed that considerable additional training is required to undertake IDR.

PhD candidates were less likely than researchers to consider IDR less likely to be funded than monodisciplinary research. Between 22-31% of PhD candidates across the four research macro areas expressed this view compared to 36-41% of researchers. PhD candidates are also less likely than researchers to think that this is because of the disciplinary focus of reviewers (those that agreed or strongly agreed totalled 39%-62% for PhD candidates versus 86%-91% for researchers). Similarly they saw the focus of funding opportunities as a disadvantage less often (37%-67% for PhD candidates versus 76%-85% for researchers).

Some PhD candidates felt that IDR was more likely to be funded than monodisciplinary research. The proportion of PhD candidates with this view was between 15% and 28% across the four research macro areas, similar in proportion to those of the researchers across the four areas (21%-28%) that held this view. However, there is difference in support for the explanation of why this might be the case (except in Engineering): PhD candidates thought less often than researchers that was IDR being funded because of higher expectations of impact of IDR (about 33% versus 76% who agreed or strongly agreed). They also were less likely to agree or strongly agree that the greater emphasis of funders on IDR was relevant in explaining why IDR might be more likely to be funded (about 56% versus 70%).

In general, the analysis revealed no systematic differences between the views of PhD candidates and researchers over collaboration incentives and barriers when undertaking IDR. An exception was the case of PhD candidates in Engineering, who seem to be less concerned than researchers about communication challenges in IDR teams (42% versus

72%), but more concerned than researchers about the involvement of less rigorous disciplines (42% versus 26%).

We also found no systematic differences between the overall views of PhD candidates and researchers regarding concerns relating to the outcomes of IDR. However, PhD candidates in Social Science and Arts & Humanities were less pronounced in their concerns than researchers about the difficulties in publishing IDR outcomes in top disciplinary journals (about 40% versus 60% in Social Science; about 38% versus 55% in Art and Humanities). This was also the case with regards to the risk of IDR being undervalued by research evaluation (23% versus 59% in Social Science; 35% versus 61% in Arts & Humanities).

We explored the extent to which the views of ECRs on barriers to and incentives for IDR differ from those of researchers in the same disciplines through an econometric estimation. Specifically, we used an ordered logit regression. We regressed the agreement/influence score that respondents gave on barriers to and incentives for undertaking IDR on a dummy variable using value 1 when the respondent was an ECR, 0 otherwise. The econometric model also used the respondent's gender and amount of research funding they declared as having won in recent years as control variables.

This analysis has provided no evidence of systematic differences between ECRs and non-ECRs except in a few cases. Firstly, ECRs in Science, Engineering, and A&H are significantly more concerned than non-ECRs about the additional training required to undertake IDR ($p < 0.05$). Relatedly, ECRs in Social Science agreed significantly more than non-ECRs on the need for a strong disciplinary training to undertake IDR ($p < 0.01$). Secondly, ECRs in Science are less concerned than non-ECRs about peers considering IDR as less rigorous ($p < 0.05$), while ECRs in A&H agreed more than non-ECRs that IDR can provide better job opportunities ($p < 0.05$). Thirdly, ECRs in Engineering are less concerned than non-ECRs about the difficulties associated with producing strong IDR research proposals ($p < 0.001$) when it comes to research funding for IDR. Finally, ECRs in Science are more concerned than non-ECRs about communication challenges in and co-location of IDR teams ($p < 0.05$).

In general we can conclude from the above that where differences do exist between PhD candidates and researchers, and between ECRs and researchers, these less experienced members of the academic community seem more optimistic about the prospects for those researchers choosing to undertake IDR than their more experienced colleagues. This could reflect a generational difference in attitudes towards monodisciplinary/interdisciplinary research or it could be considered that these individuals have not yet experienced the pressures that more established colleagues have experienced.

C.3 Survey for strategic leaders

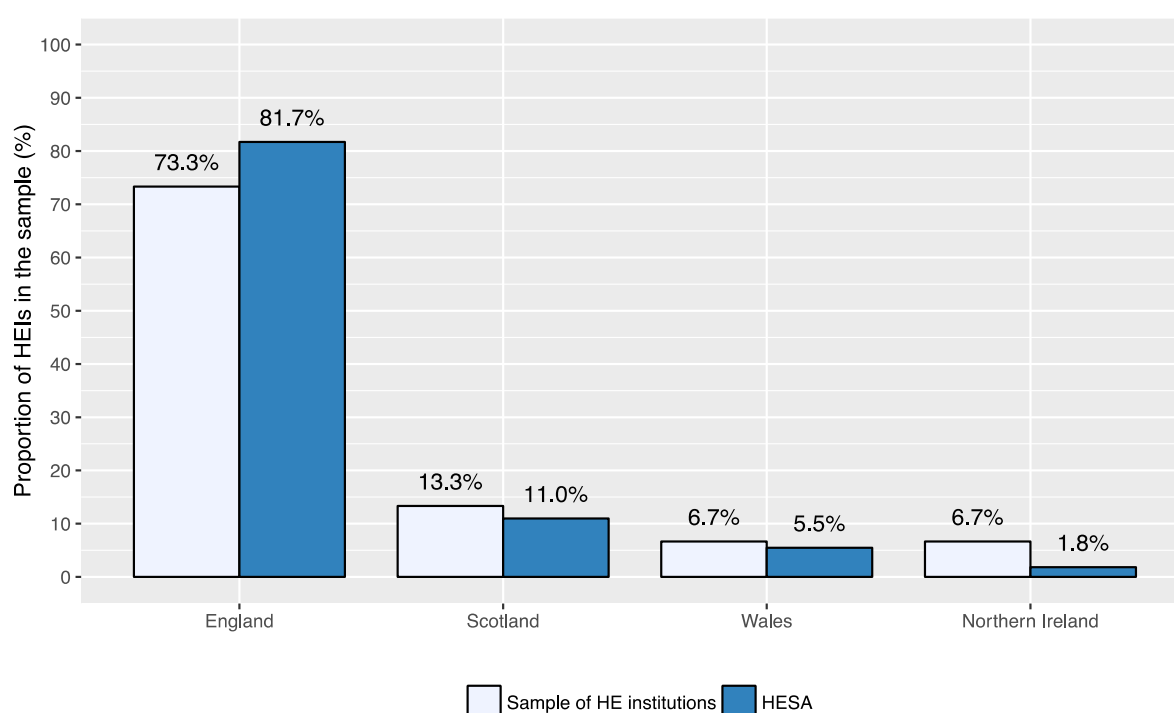
C.3.1 *Descriptive statistics on the responses from strategic leaders*

The survey of strategic leaders focussed on the perspectives of senior professional services staff, senior academic faculty with administrative positions, and researchers with management duties above the individual project level – for example Principal Investigators of individual research projects were not targeted per se, but directors of research centres were. The objectives were to gather views on barriers to and incentives for IDR, to understand how different HEIs support IDR, and to find out how established these efforts are.

The survey of strategic leaders was targeted at the entire management hierarchy of selected HEIs in order to reduce the possibility of disciplinary biases in the sample population. Specifically, the survey targeted 1,080 strategic leaders across 15 HEIs (see Methodology section for more information). The total number of responses was 367, giving an overall response rate of 34%. This is notably higher than the survey to researchers, possibly in part because personalised email invitations were sent to these individuals (Sauermann and Roach, 2013). However, another explanation is that senior individuals see addressing the challenges of IDR as more important than junior colleagues (given the profile of respondents in the researcher survey).

Figure 17 shows the sample of HEIs contacted for the survey against the proportion of HEIs in each UK nation based on HESA data. The sample tends to underrepresent HEIs in England (-8%) and to overrepresent HEIs in Scotland (+2%), Wales (+1%), and Northern Ireland (+5%). These differences are low, but they may affect the probabilities of strategic leaders in certain nations being selected for the survey. We therefore correct for this by introducing *base weights* – defined as the number of HEIs in each nation out of the number of HEIs in our sample.

Figure 17 Distribution of HEIs by nation in the sample compared with HESA data



Also, as reported in Figure 18, response rates varied greatly between ‘large HEIs’ (i.e., those that submitted more than 600 FTE to the last REF) and ‘medium/small HEIs’ (i.e., those that submitted less than 600 FTE to the last REF). The response rate for medium/small HEIs ranged from 9% up to 54%, while it ranged from 27% to 41% for large HEIs.

Overall the following results were collected: 204 responses out of 600 contacts from large HEIs (34%) and 163 responses out of 480 contacts from medium/small HEIs (also 34%). To adjust for the different response rates from individual HEIs, *non-response weights* were used (defined as the inverse of the response rate of a given institution).

Figure 18 Response rate by participating HEIs

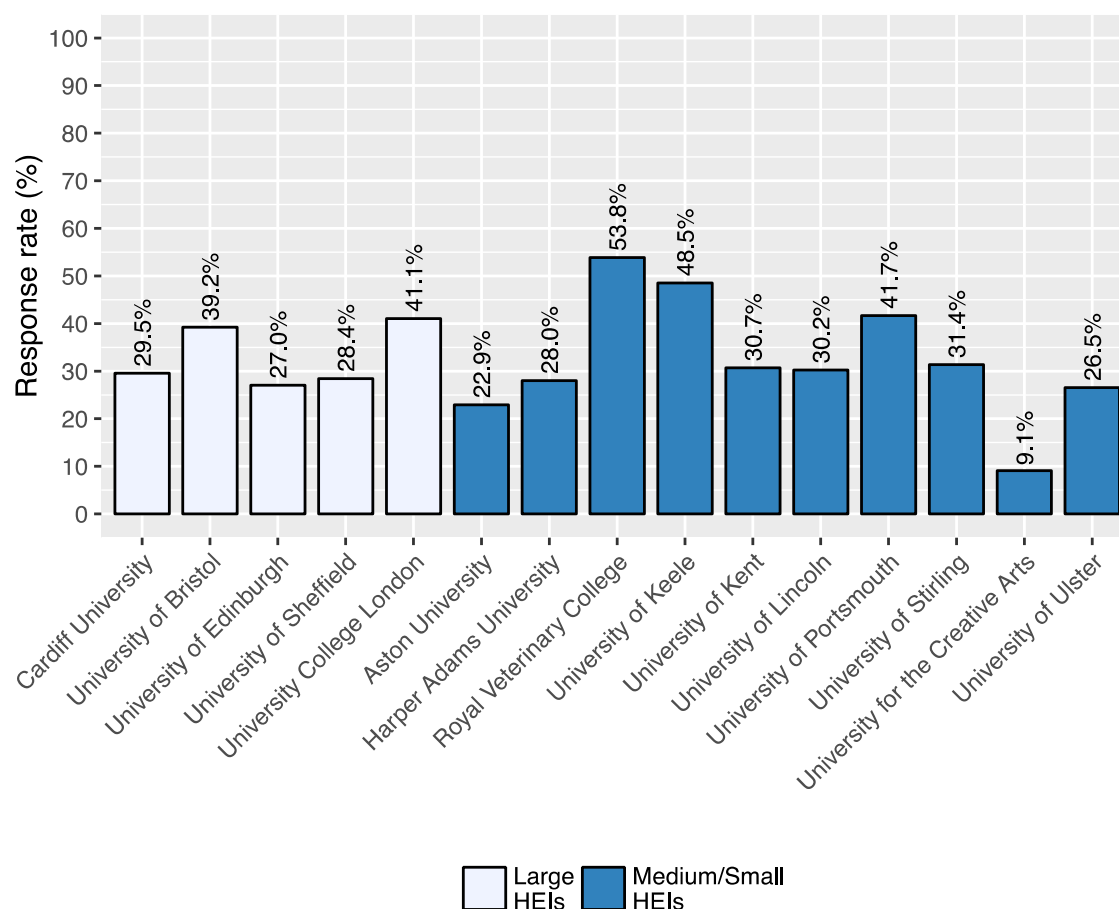
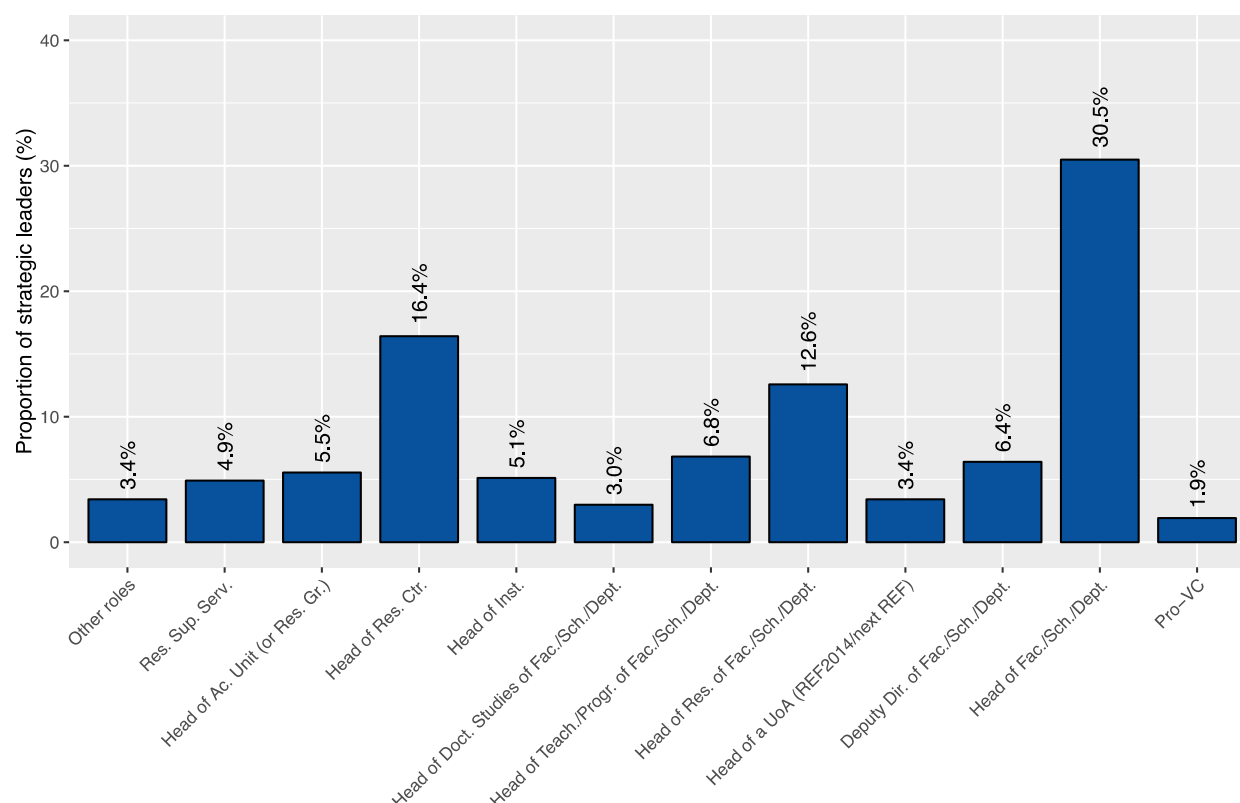


Figure 19 shows the range of management responsibilities that respondents reported. Respondents were able to report multiple options. These results are provided for illustrative purposes only, but it is notable that the single largest group of respondents are heads of departments, schools, or faculty (31%), followed by heads of research centres (16%) and research leads for departments, schools, or faculty (13%).

Our dataset of respondents included 66% males and 32% females (see Figure 20). Therefore, the respondent population of the survey for strategic leaders shows a strong bias towards male respondents. It is unclear if this is due to a response bias for males to complete the survey, a bias in the UK strategic leaders' population towards males, or both these factors combined. It is worth noting that the survey for researchers had a bias towards male respondents, and that this was in addition to a bias in the gender balance of UK HE staff in general (as reported in the HESA data).

Figure 19 Management roles of respondents (respondents in multiple management roles are counted across all these roles)



Given the lack of comprehensive statistics of the composition of the population of strategic leaders, it was not possible to understand whether the gender biases in the dataset of responses is more pronounced than in the population as a whole. As a consequence, *post-stratification* weights could not be calculated or introduced. The interpretation of the results as reported should be borne in mind as predominantly representing the views of male strategic leaders.

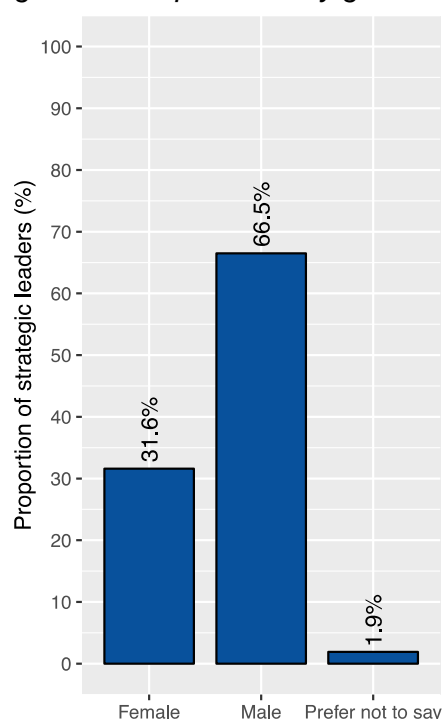
C.3.2 Results

The following sections analyse the responses of strategic leaders on perceived importance of IDR and perceived and experienced barriers to and incentives for IDR. In order to take into account the context of respondents, the analysis makes the distinction between respondents from 'large HEIs' and respondents from 'medium/small HEIs'.

We first explore perceived barriers to and incentives for IDR and then we focus the analysis of these along four themes (i) career, (ii) funding, (iii) collaboration, and (iv) research outcomes.

As discussed in the previous sections, post-stratification weights on factors such as gender and contract type (as used in the survey for researchers) could not be used in the strategic leader survey because of insufficient information on the population of strategic leaders in the UK as a whole. However the analyses below are adjusted by two different types of weights: base weight and non-response rate by HEI.

Figure 20 Respondents by gender



Importance and prioritisation of IDR

Figure 21 provides contextual information for the survey by establishing the importance of IDR from the respondent's perspective and their perspective on whether IDR is important for their HEI.

The results indicate that strategic leaders in large HEIs consider IDR as extremely important or very important for their organisation in 92% of cases (and 59% of these see IDR as extremely important). At medium/small HEIs IDR is seen as extremely important or very important by 85% of respondents – the majority (45%) of these seeing IDR as extremely important. The differences between the distribution of perceptions of importance for IDR for their organisations are statistically significant when considering institution size (K-W test on distributions: $p < 0.01$).

Having established strategic leaders' views on the importance of IDR for their HEIs, they were asked whether they saw IDR as an organisational priority. 92% of strategic leaders from large HEIs and 85% from medium/small HEIs suggested that IDR was a priority at their HEIs – there is no statistically significant difference between the two groups.

Figure 21 Importance of IDR from (a) the respondent's own perspective and (b) their perception of whether IDR is a priority for their HEI (proportions <5% are not labelled)

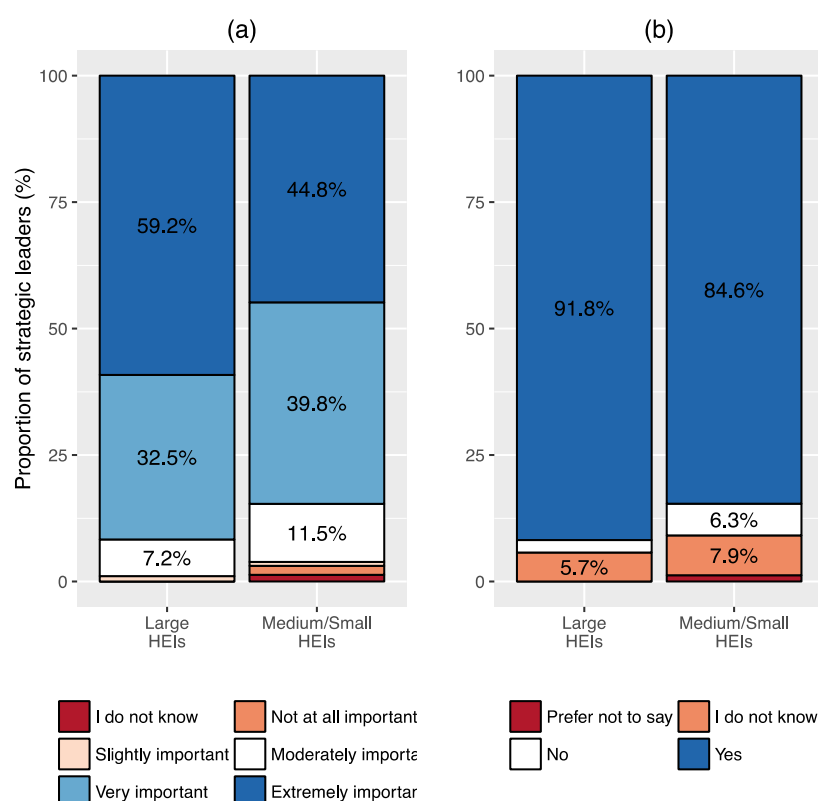
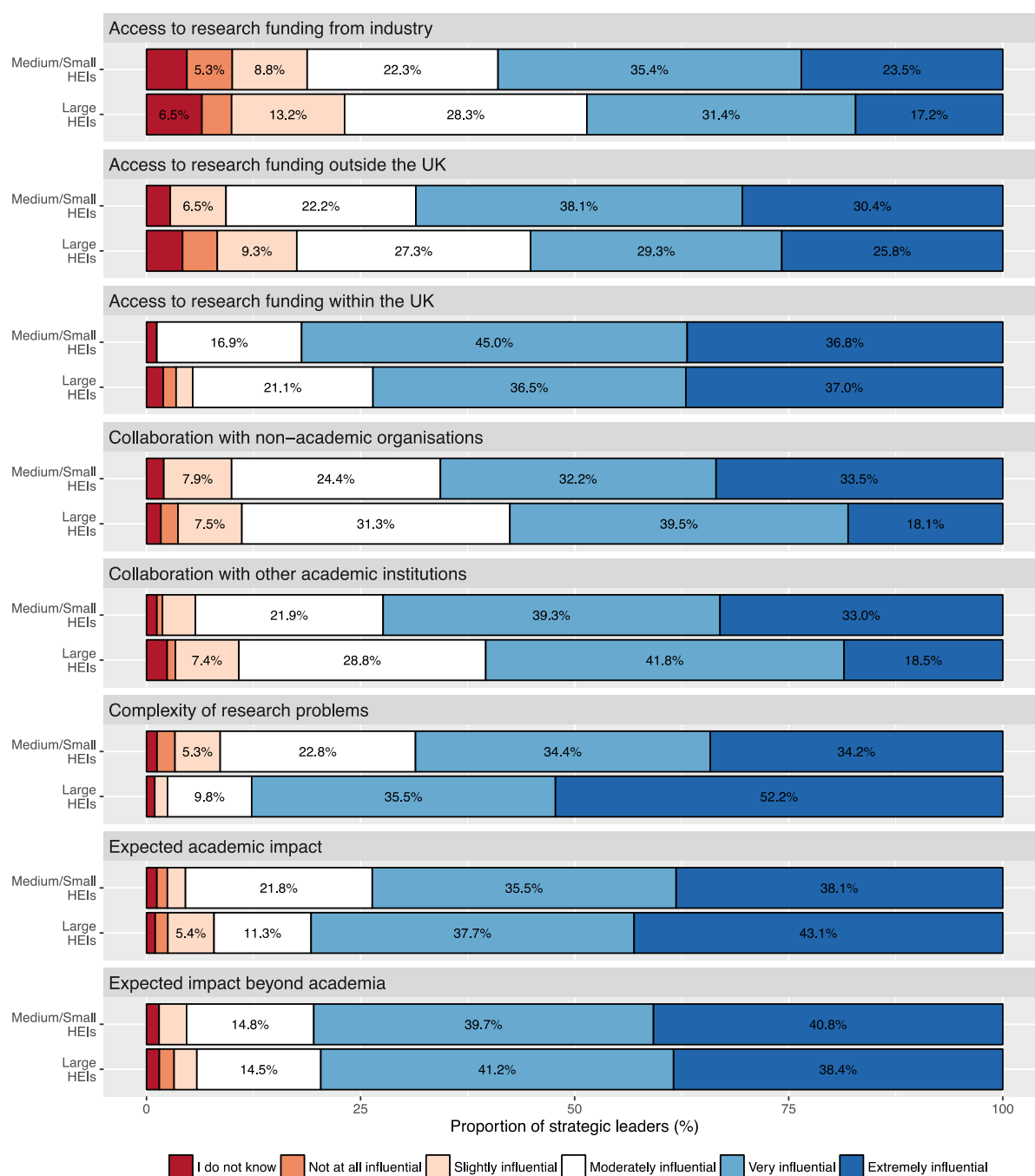


Figure 22 explores the extent to which strategic leaders perceive a range of factors as affecting the priority given to IDR at their HEIs. The vast majority of strategic leaders confirmed they thought that access to funding from UK, non-UK, and industry sources, as well as access to academic and non-academic collaborators, were to some degree influential in making IDR a priority. IDR was also seen as important for addressing more complex research problems and for achieving academic and non-academic impact.

The ability of IDR to address complex research problems was agreed to be a reason for it being a priority by strategic leaders in large HEIs significantly more frequently than by their colleagues in medium/small HEIs (*K-W test on distributions*: $p < 0.001$).

The reverse was the case for accessing research funding from outside the UK, where medium/small HEIs' strategic leaders thought this was more influential (*K-W test on distributions*: $p < 0.05$), and they also were more likely to think this was the case for collaboration with academics (*K-W test on distributions*: $p < 0.01$) and non-academics (*K-W test on distributions*: $p < 0.05$).

Figure 22 Factors that motivate prioritisation of IDR in HEIs (proportions <5% are not labelled)



Support for IDR

Respondents were asked how well established support for IDR was at their HEIs and about the specific mechanisms used to support IDR. Responses to these questions reveal the leading mechanisms employed, those less used, and a number of important differences between large and medium/small HEIs.

Figure 23a shows that strategic leaders at large HEIs much more frequently perceive that support for IDR is strongly established in their organisations than is the case in

medium/small HEIs (36% versus 14%) or somewhat established (50% versus 43%). The difference between the two distributions shown is highly significant from a statistical perspective (*K-W test on distributions: $p < 0.001$*).

The most frequently reported mechanisms used to support IDR in the sample by large and medium/small HEIs (i.e. those identified by at least 50% of respondents) are: (i) the development of internal research networks; (ii) dedicated IDR centres/institutes; (iii) internal research funding; and (iv) the development of research networks with other HEIs.

Figure 23b shows large differences in the frequency with which mechanisms are reported as being used by large and medium/small HEIs, with the majority of measures more often being reported as used in large HEIs than medium/small HEIs (in keeping with findings in *Figure 23a*). The differences shown in *Figure 23b* are statistically significant ($\chi^2: p < 0.05$) in the following cases: (i) providing dedicated spaces for IDR; (ii) dedicated IDR centres/institutes; initiatives and funding to take up findings of IDR; (iii) training for IDR researchers, training for IDR students; and (iv) recruitment of IDR researchers. An interpretation here is that large HEIs are able to better resource IDR initiatives than medium/small HEIs.

Mechanisms least reported as used by large HEIs are reward and progression policies for staff (26% of respondents), preparatory mechanisms for external research evaluation (27% of respondents), and dedicated collaboration spaces for IDR (27% of respondents). The least reported mechanisms at medium/small HEIs include dedicated spaces for IDR (11% of respondents), reward and progression policies for staff (18% of respondents), and initiatives and funding to take up findings from IDR (20% of respondents).

Perceived barriers to IDR

Strategic leaders were asked to judge the extent to which certain factors influenced the willingness of researchers in their organisations to undertake IDR. *Figure 24* shows the responses of the strategic leaders to the influence of key factors that could act as barriers to IDR.

Strategic leaders at large HEIs (37%) and medium/small HEIs (35%) estimated that career progression concerns would be very or extremely influential for researchers. Although the large HEIs' strategic leaders estimated a higher share of their researchers would not be influenced by this, the overall difference between the two distributions is not statistically significant.

Concerns over career progression were higher among strategic leaders (35% to 37% of respondents) than researchers (18% to 34% of respondents). Researchers indicated in much larger numbers (30% to 38%) than their strategic leaders (11% to 17%) that they were not at all influenced by concerns over career progression.

Figure 23 Support of IDR (a) and mechanisms implemented to support IDR in HEIs (b) (proportions <5% are not labelled)

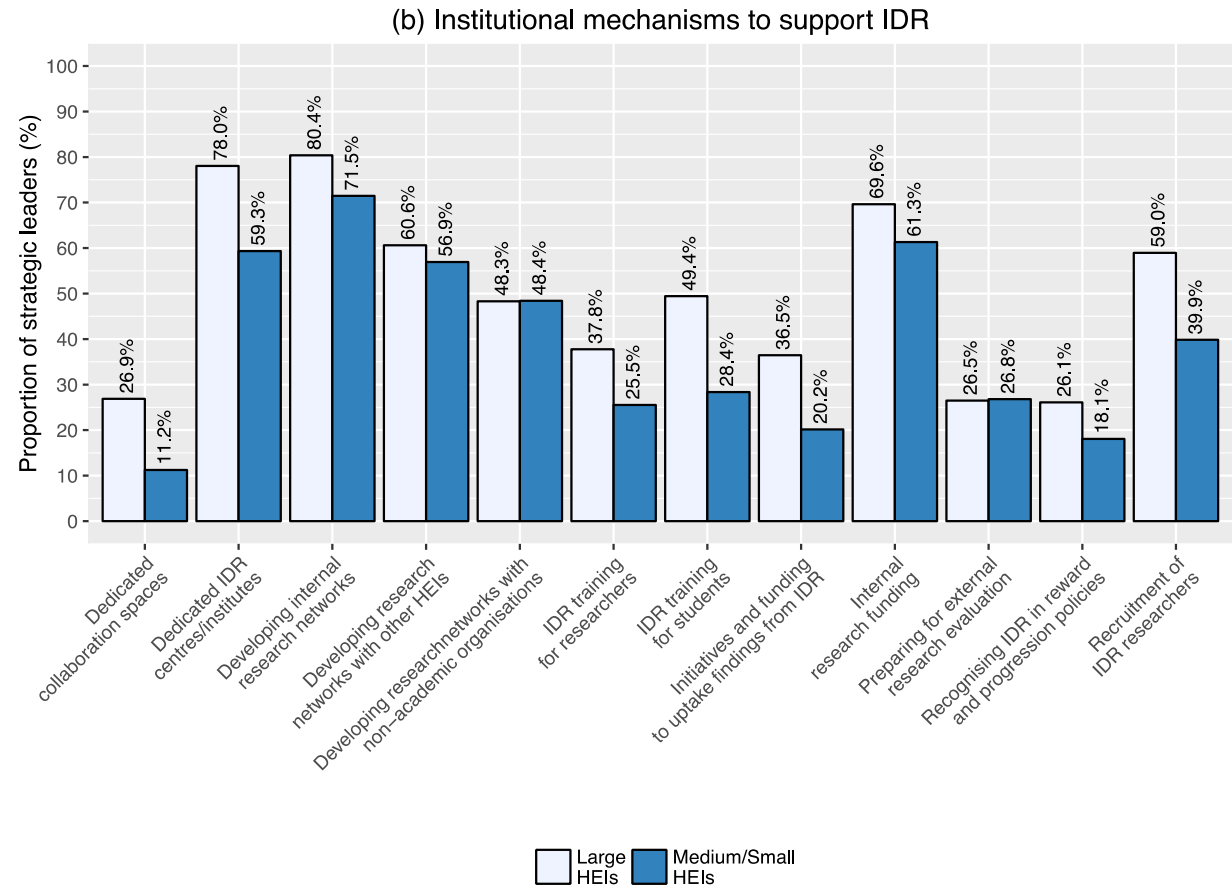
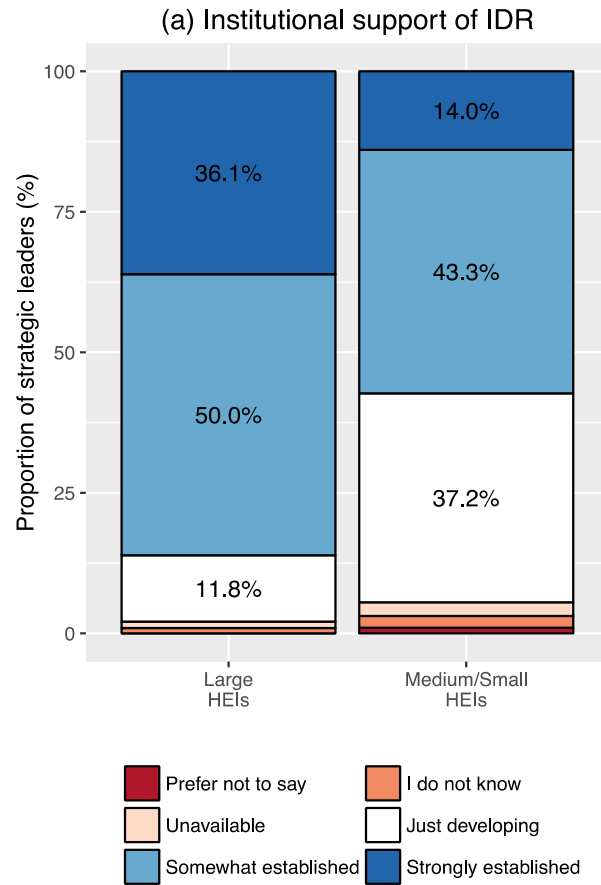
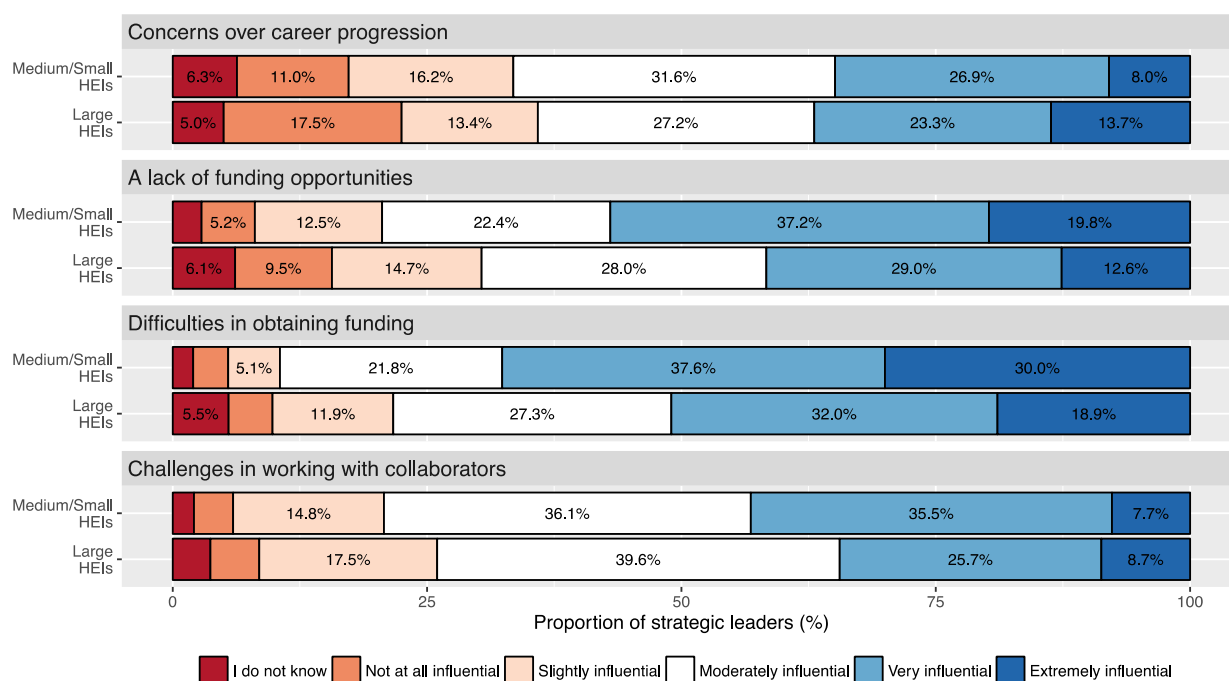


Figure 24 Perceived barriers to IDR by research area (proportions <5% are not labelled)



A lack of funding opportunities and difficulties in obtaining funding were problems that medium/small HEIs' strategic leaders reported as a concern to their staff significantly more frequently than the strategic leaders of large HEIs. 42% of large HEIs' strategic leaders thought concern about 'a lack of funding opportunities' was extremely or very influential, compared to 57% of respondents at medium/small HEIs (*K-W test on distributions: $p < 0.05$*). 51% of large HEIs' strategic leaders versus 68% of medium/small HEIs' strategic leaders identified 'difficulties in obtaining funding' as very or extremely influential (*K-W test on distributions: $p < 0.01$*). Although large HEIs' strategic leaders saw challenges in IDR collaborations as strongly or very influential somewhat less frequently (34% versus 43%) than those in medium/small HEIs, the difference overall in responses to this issue was not significant.

IDR and career

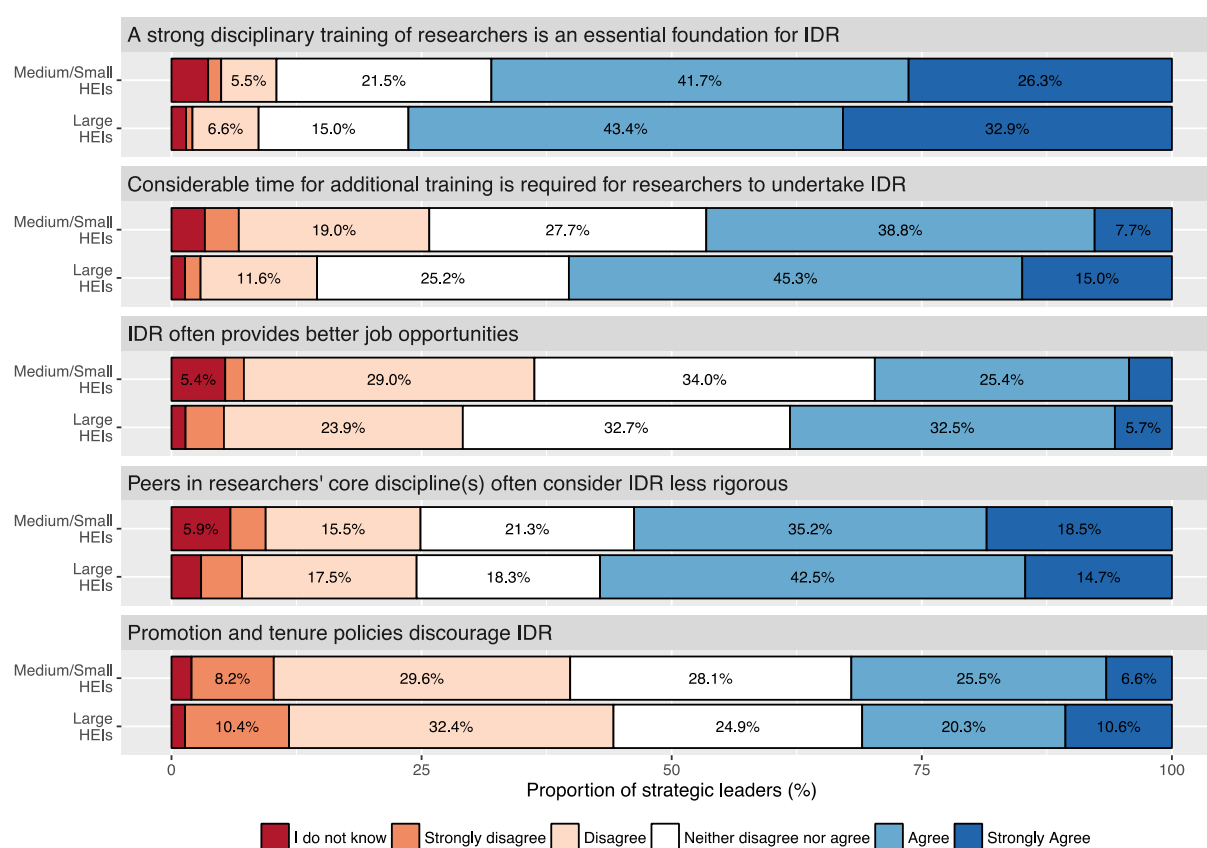
A large majority of strategic leaders thought that strong disciplinary training is an essential foundation for IDR. There was no significant difference between the groups, although 76% of large HEIs' strategic leaders compared to 68% of medium/small HEIs' strategic leaders agreed or strongly agreed with this view (see Figure 25).

There was less consensus around whether considerable time was required for additional training to undertake IDR: 60% of respondents employed in large HEIs agreed or agreed strongly compared to 47% of medium/small HEIs' respondents. There was more frequent disagreement and strong disagreement (22%) from medium/small HEIs' respondents compared to large HEIs' respondents (13%). These differences between the distributions of

the responses of the two groups are statistically significant (*K-W test on distributions: $p < 0.01$*).

There was no strong consensus amongst strategic leaders on whether IDR often provides better job opportunities. Better job opportunities for IDR researchers were thought to be likely by a slightly higher number of large HEI's respondents (38% versus 30%), while for medium/small HEIs' respondents the most common view was the neutral option (34%). There was, however, no statistically significant difference between large and medium/small HEIs' respondents overall.

Figure 25 IDR and career (proportions <5% are not labelled)



54% of strategic leaders at medium/small HEIs and 57% of those at large HEIs agreed or strongly agreed that IDR was more likely to be viewed as less rigorous by peers in the disciplinary core – there was no statistically significant difference between the two groups.

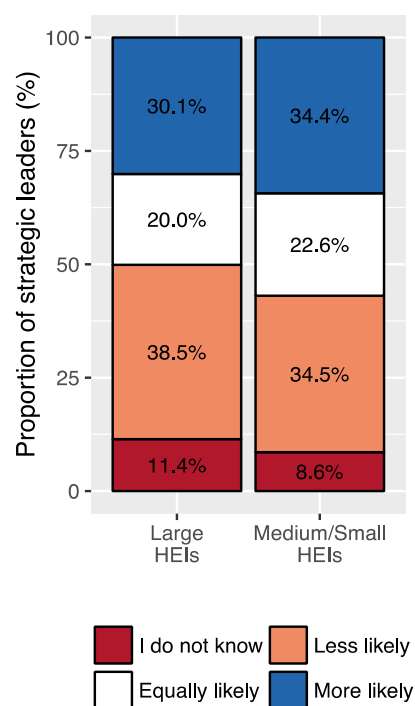
There was more disagreement than agreement with the statement that IDR was discouraged by promotion and tenure policies, with respondents at large HEIs disagreeing or strongly disagreeing with this view slightly more often than medium/small HEIs' respondents (43% versus 38% respectively) although there was no statistically significant difference between the two groups.

In the free text responses in this section, a number of strategic leaders (n=55) made comments. Some (n=11) noted that the specificity of advancement criteria often makes IDR look weak and too broad, thus reducing the likelihood of career advancement: “Promotion and tenure policies are still constructed around traditional monodisciplinary structures”, one respondent wrote. Additionally, the lack of training opportunities for IDR researchers was noted as a particular barrier (n=5). Finally, some comments mentioned that IDR in itself is not intrinsically good but that it must still be subject to notions of what makes ‘good’ quality research (n=3).

IDR and funding

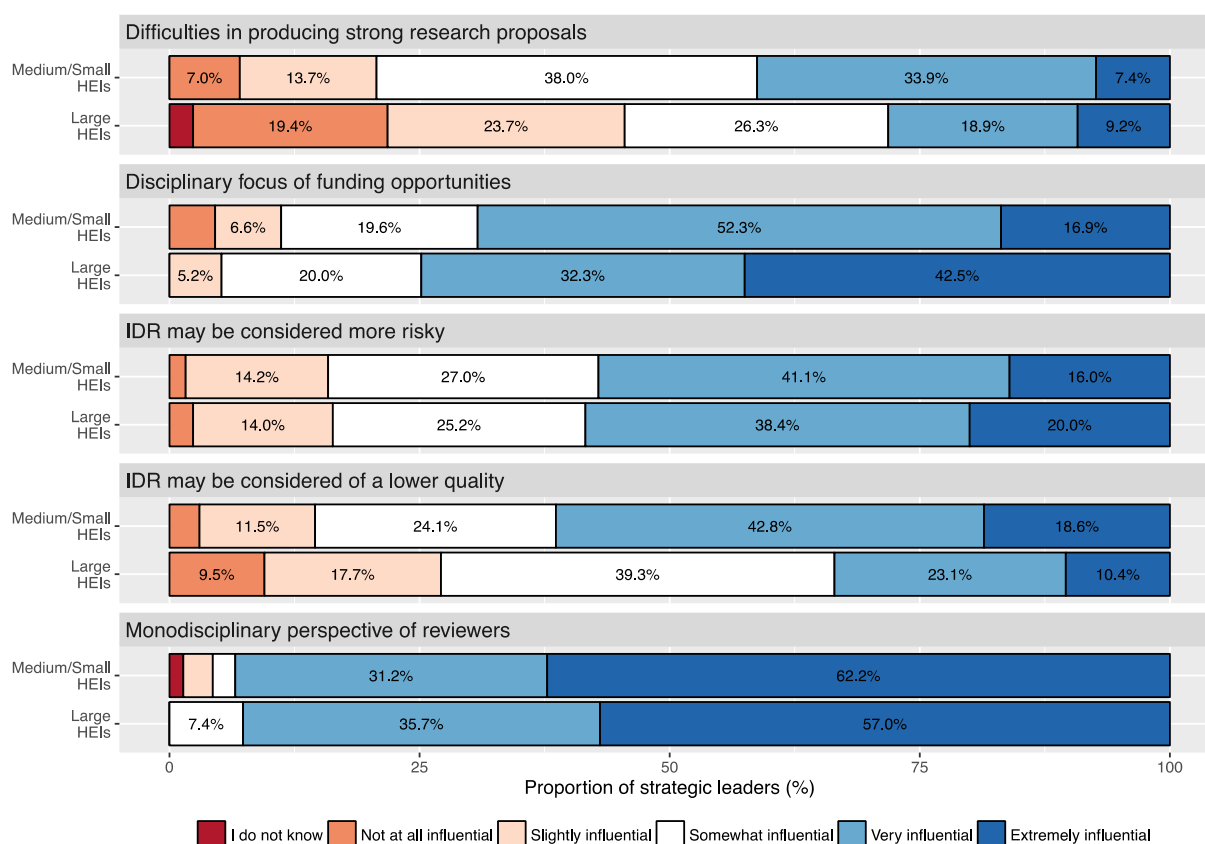
The survey of researchers showed that between 37% and 41% of respondents across the four research macro areas thought that IDR was less likely to be funded than monodisciplinary research. However, *Figure 26* shows that respondents to the survey for strategic leaders did not give the same clear message. In agreement with the researchers, 39% of strategic leaders at large HEIs’ thought that IDR was less likely to be funded,

Figure 26 Likelihood of IDR being funded



but the views of strategic leaders at medium/small HEIs were more evenly balanced, with no overall view. The differences in the two distributions of large and medium/small HEIs’ strategic leaders were also not statistically significant. Strategic leaders that thought IDR was less likely to be funded were asked which factors contributed to that outcome. The results, summarised in *Figure 27* show some areas of common agreement and important differences.

Figure 27 IDR perceived as less likely to be funded (proportions <5% are not labelled)

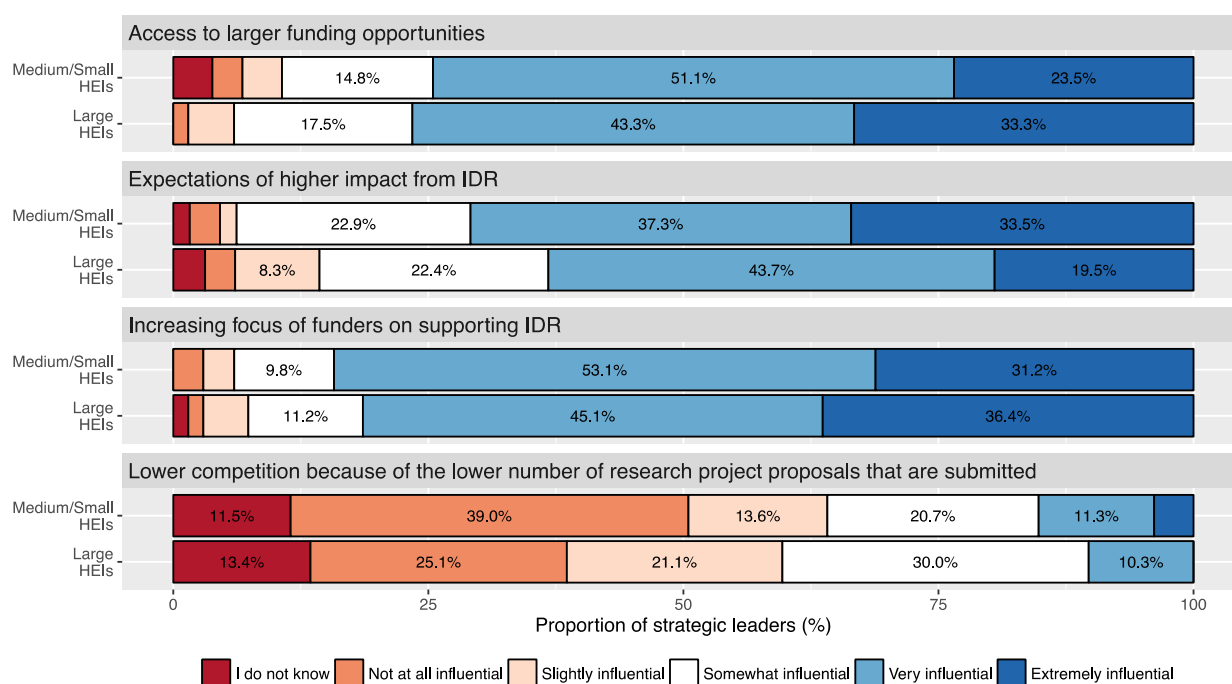


Agreement is strongest that the monodisciplinary perspectives of reviewers and the disciplinary focus of funding opportunities were important factors. 93% of strategic leaders considered the monodisciplinary perspectives of reviewers as a very or extremely influential factor. 69% of respondents at medium/small HEIs and 75% of respondents at large HEIs considered the disciplinary focus of funding opportunities as a very or extremely influential factor. However, large HEI respondents felt that this was an extremely influential factor to a greater extent than medium/small HEI respondents (42% versus 17%) – the differences between the distributions of the responses of the two groups were statistically significant (*K-W test on distributions: $p < 0.01$*).

Strategic leaders at large and medium/small HEIs disagreed over the extent to which they perceived difficulties producing strong research proposals to obtain funding for IDR. 41% of medium/small HEIs' respondents thought that such difficulties were influential or strongly influential in making IDR less likely to be funded, compared to 28% of large HEIs' respondents. Furthermore, while only 7% of those responding from medium/small HEIs thought that difficulties in producing strong proposals were not at all influential, the corresponding figure was 19% at the large HEIs. The difference between the distributions of the responses of the two groups was statistically significant (*K-W test on distributions: $p < 0.05$*).

The majority of large and medium/small HEIs' respondents (58% and 57% respectively) also agreed that IDR may be considered more risky and that this was a factor influential in creating funding difficulties for IDR. There was little difference between the two sets of responses.

Figure 28 IDR perceived as more likely to be funded (proportions <5% are not labelled)



33% and 61% of large and medium/small HEIs' respondents respectively felt that IDR is less likely to be funded because it may be considered of lower quality compared to monodisciplinary research. The difference between the groups was statistically significant (*K-W test on distributions: $p < 0.01$*).

Many free text responses to these statements ($n=23$) centred around the monodisciplinarity of funding panels, and the lack of training panel members receive for reviewing interdisciplinary proposals ($n=9$). A recurring theme in comments included the structure of the funding bodies themselves, which often precludes proposals that 'fall between the cracks' ($n=3$).

Figure 28 shows the views of the strategic leaders that thought IDR was more likely to be funded than monodisciplinary research, exploring which factors may contribute to this situation. Strategic leaders from large and medium/small HEIs did not significantly differ in their views on this point.

Agreement was strongest that IDR benefitted from the increasing focus of funders on IDR (82% of large HEIs' respondents and 84% of medium/small HEIs' respondents thought this factor was extremely influential or very influential). There was also strong agreement that access to larger funding opportunities benefitted IDR (77% of large HEIs' respondents and

75% of medium/small HEIs' respondents thought this factor was extremely influential or very influential).

The expectation that IDR would lead to higher impact was thought to be very or extremely influential by 63% of large HEIs' respondents and 71% of medium/small HEIs' respondents.

There was less agreement with the statement that IDR faced lower competition due to a smaller number of bids. 10% to 15% of respondents considered this factor as very or extremely influential, while 25% of large HEIs' respondents and 39% of medium/small HEIs' respondents thought that this factor was not at all influential.

A relatively smaller number of strategic leaders followed their answers to the "IDR is more likely to be funded" statement with a free text response (n=8). One key point to draw out is that some noted that the REF favours IDR indirectly: "[the] REF has also played an important role, not just through the introduction of impact as a key element, but also panel feedback supporting inter-disciplinary research".

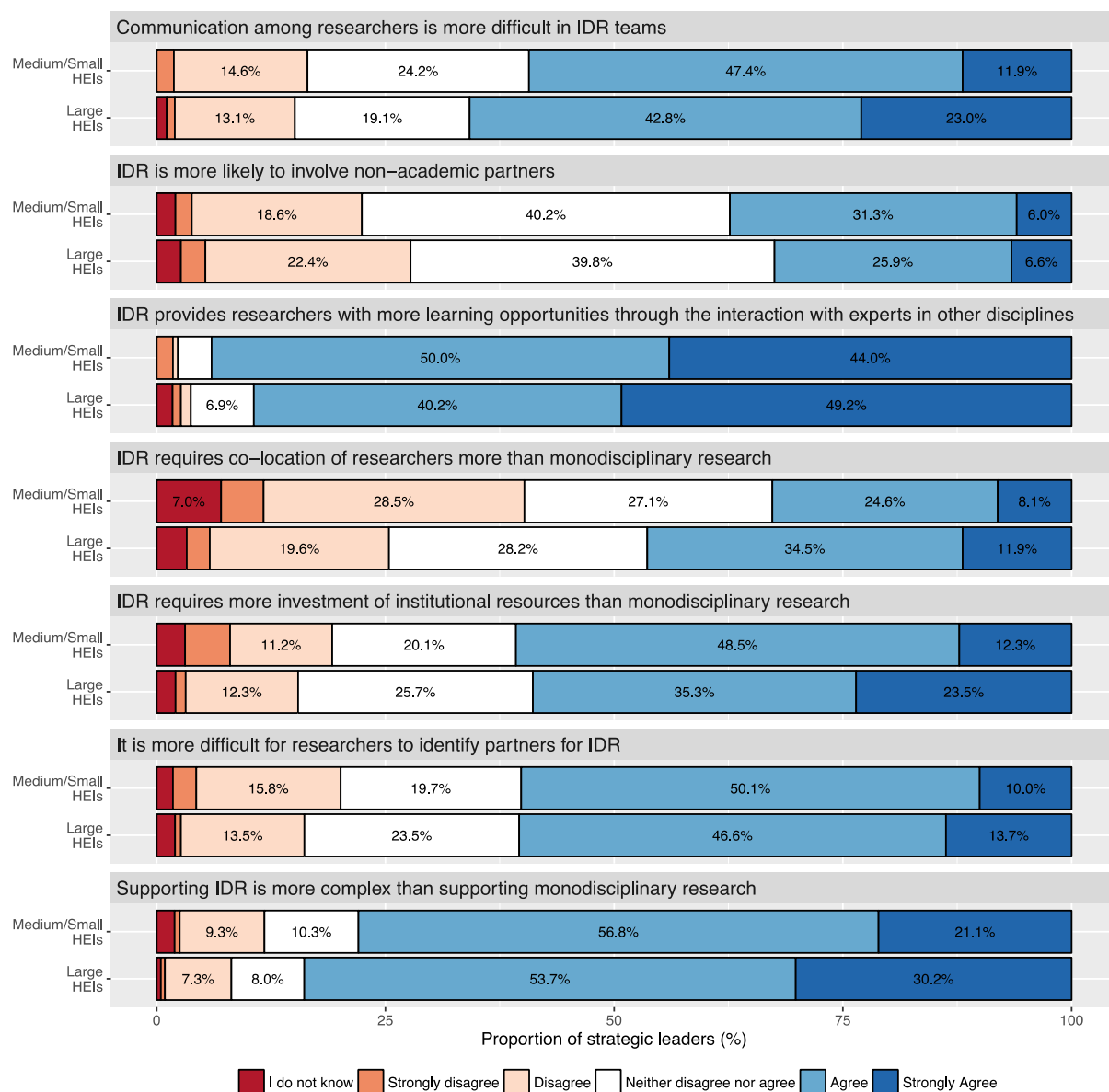
IDR and collaboration

Figure 29 explores barriers to and incentives for IDR that relate to collaboration. There are a number of areas of general agreement amongst the majority of strategic leaders when it comes to the topic of IDR and collaboration, but also a few significant differences between the distribution of views from respondents belonging to the two groups of HEIs. The key differences came from responses to the question of communication between IDR team members and the need for co-location to support IDR.

At large HEIs there was more support for the view that communication is more difficult in IDR teams than at medium/small HEIs (with 66% and 59% respectively agreeing or strongly agreeing with this proposition). Strategic leaders at large HEIs were nearly twice as likely to express the strongest agreement as those at medium/small HEIs (23% versus 11.9%). The difference between these distributions is significant (*K-W test on distributions: $p < 0.05$*).

A stronger difference between large and medium/small HEIs is apparent in relation to the proposition that IDR requires co-location of researchers more than monodisciplinary research. 46% of large HEIs' respondents agreed or strongly agreed with this proposition, compared to 33% of medium/small HEIs' respondents – at medium/small HEIs, another 33% of respondents disagreed or strongly disagreed with the proposition. The difference between the distributions of responses is significant (*K-W test on distributions: $p < 0.01$*).

Figure 29 IDR and collaboration (proportions <5% are not labelled)



In all other responses there were no significant differences between the two groups of HEIs, although a lack of strong agreement within these groups was apparent on the proposition that IDR is more likely to involve non-academic partners. Those agreeing or strongly agreeing with the proposition (32% and 37% of large and medium/small HEIs' respondents respectively) were outnumbered by those that had a neutral view (around 40% in the large and medium/small HEIs groupings).

89% of respondents at large HEIs and 94% at medium/small HEIs supported the proposition that interdisciplinary research provides researchers with more learning opportunities through interaction with experts in other disciplines.

Across HEIs from 59% to 61% of respondents agreed or strongly agreed that IDR requires more investment of institutional resources than monodisciplinary research. There is no significant difference between the two groups in their overall support for the proposition although large HEIs' respondents were almost twice as likely to strongly agree as medium/small HEIs' respondents (24% compared to 12%).

60% of strategic leaders at large and medium/small HEIs agreed or strongly agreed that it is more difficult for researchers to identify partners for IDR, while 84% of large HEI and 78% of medium/small HEIs' respondents agreed or strongly agreed that supporting IDR is more complex than supporting monodisciplinary research.

The free text responses of strategic leaders (n=28) in this section reveal some commonalities around resource allocation and university structures. It was noted by some (n=5) that IDR research requires higher initial funding and that the proposal takes more work and time to construct (n=3). Others (n=2) noted that the university structures themselves also impeded IDR because the disciplinary units and funding models increased administrative load for IDR; one strategic leader stated: "Genuine interdisciplinarity remains a challenge, and although many institutions (including my own) pay lip service to the concept, few invest the necessary resources".

IDR and outcomes

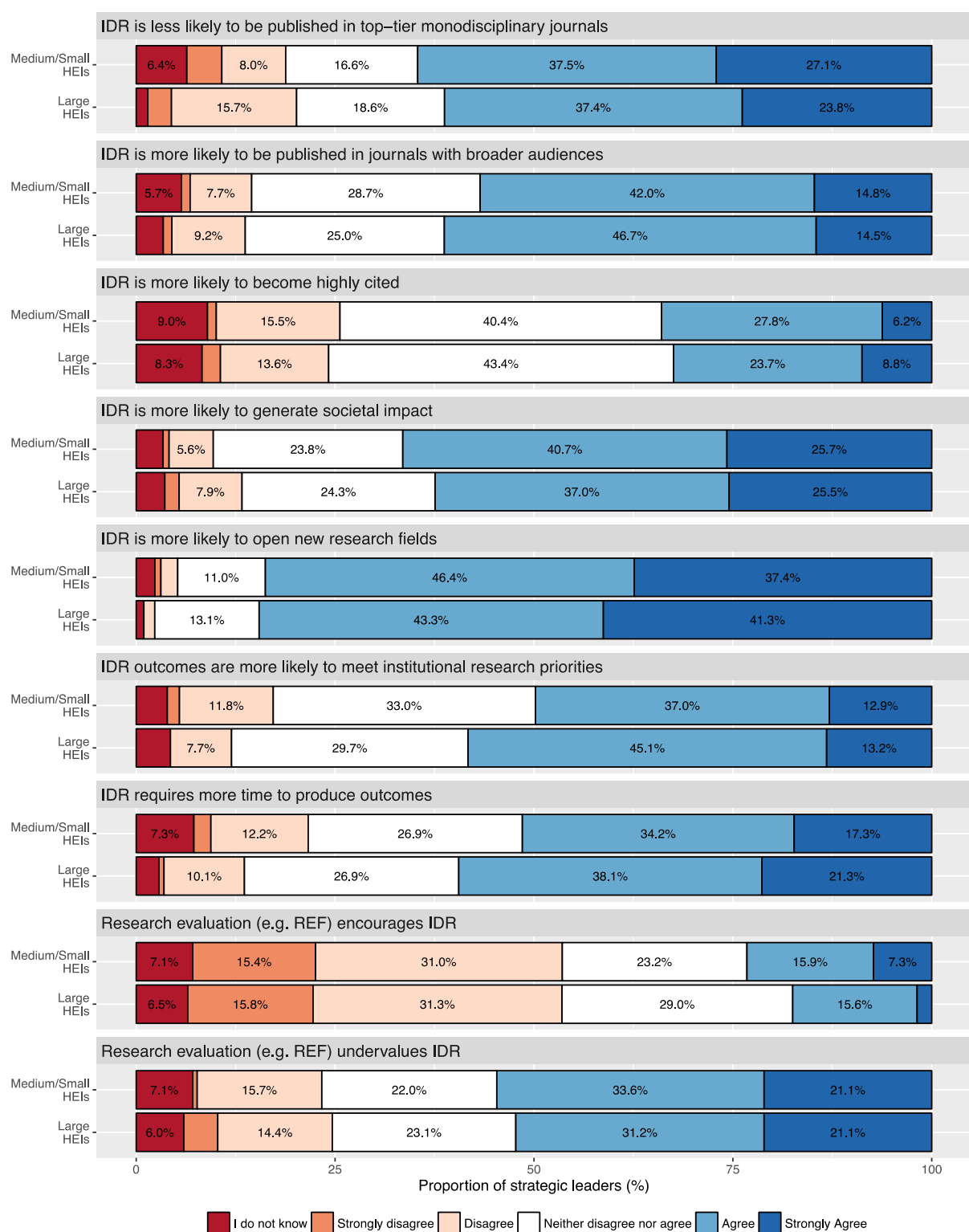
Figure 30 explores barriers to and incentives for IDR that relate to research outcomes as perceived by strategic leaders. There were no statistically significant differences to report between respondents from large and medium/small HEIs.

61% of strategic leaders at medium/small HEIs and 65% of those at large HEIs agreed or strongly agreed with the proposition that IDR is less likely to be published in top-tier monodisciplinary journals. Similarly, 57% of respondents at medium/small HEIs and 61% at large HEIs agreed or strongly agreed with the proposition that IDR is more likely to be published in journals with broader audiences. Respondents were, however, more neutral when asked if IDR is more likely to become highly cited – from 40% to 43% of respondents neither agreed or disagreed with the proposition.

In addition, 63% of large HEIs' respondents and 66% of medium/small HEIs' respondents agreed or strongly agreed with the proposition that IDR is more likely to generate societal impact; while 84%-85% of respondents supported the proposition that interdisciplinary research is more likely to open new research fields – only 11%-13% of respondents were neutral.

Respondents varied (but not significantly) in their support for the proposition that IDR research outcomes were more likely to meet their institutions' research priorities. 58% of large HEIs' strategic leaders supported this proposition compared to 50% of medium/small HEIs' respondents. 30% to 33% of respondents took a neutral view on this statement.

Figure 30 IDR and research outcomes (proportions <5% are not labelled)



51% to 59% of strategic leaders agreed or strongly agreed with the proposition that IDR requires more time to produce outcomes. However, only 11% to 14% of respondents were in disagreement, while 27% of respondents from both groups were neutral.

Asked if research evaluation (e.g. REF) encourages IDR, strategic leaders were much more likely to disagree than agree. 46% to 47% of respondents disagreed or disagreed strongly with this proposition. In contrast 17% of large HEIs' respondents and 23% of medium/small HEIs' respondents agreed or agreed strongly with the proposition that research evaluation encourages IDR.

A majority of strategic leaders also thought that research evaluation (e.g. REF) undervalues interdisciplinary research, with 52% of large HEIs' respondents and 55% of medium/small HEIs' respondents supporting this view. 19% of large HEIs' respondents and 16% of medium/small HEIs' respondents instead disagreed or disagreed strongly with this statement.

Free text comments on the question of REF (n=25) generally focussed on two areas. First, an 'it depends' component was introduced (similar to the researchers' survey) in that the quality of outcomes are perceived to be irrespective of the level of monodisciplinarity or interdisciplinarity but vary from project to project and from output to output. Secondly, as in the survey for researchers, the REF was seen as a barrier. This was also not just in response to this question but across all the free text questions in the survey.

C.4 Survey for funders

C.4.1 Descriptive statistics of the responses from managers in funding organisations

The survey for funders aimed at capturing the perspectives of research managers, portfolio managers, and directors in public and third sector funding organisations, and to compare these with data collected from the other two surveys for researchers and for strategic leaders. As described in the Methodology section, 118 contacts for research managers in RCUK and UK funding bodies and 844 emails addresses from 422 funders (e.g. charities, foundations, and professional societies) were identified and targeted. This yielded an overall set of 94 responses that we describe in the following sections.

Figure 31 reports the proportion of responses from research managers by the budget their organisations allocate to research. About 38% of the respondents were employed in funding organisations with a research budget of more than £100 million. These included research managers from RCUK and the UK funding bodies as well as managers in large charities such as Cancer Research UK and Wellcome Trust. The remaining funders were distributed across funding organisations with research budgets ranging from £10 million to £100 million (7% of respondents), from £1 million to £10 million (19% of respondents), and less than £1 million (35% of respondents). We used this information to distinguish between responses from two groups: managers employed in minor funding organisations, defined as organisations with a research budget of up to £100M, and managers in major funding organisations, i.e. funders with a research budget of more than £100 million (*Figure 31*).

Figure 31 Proportion of respondents by funder research budget

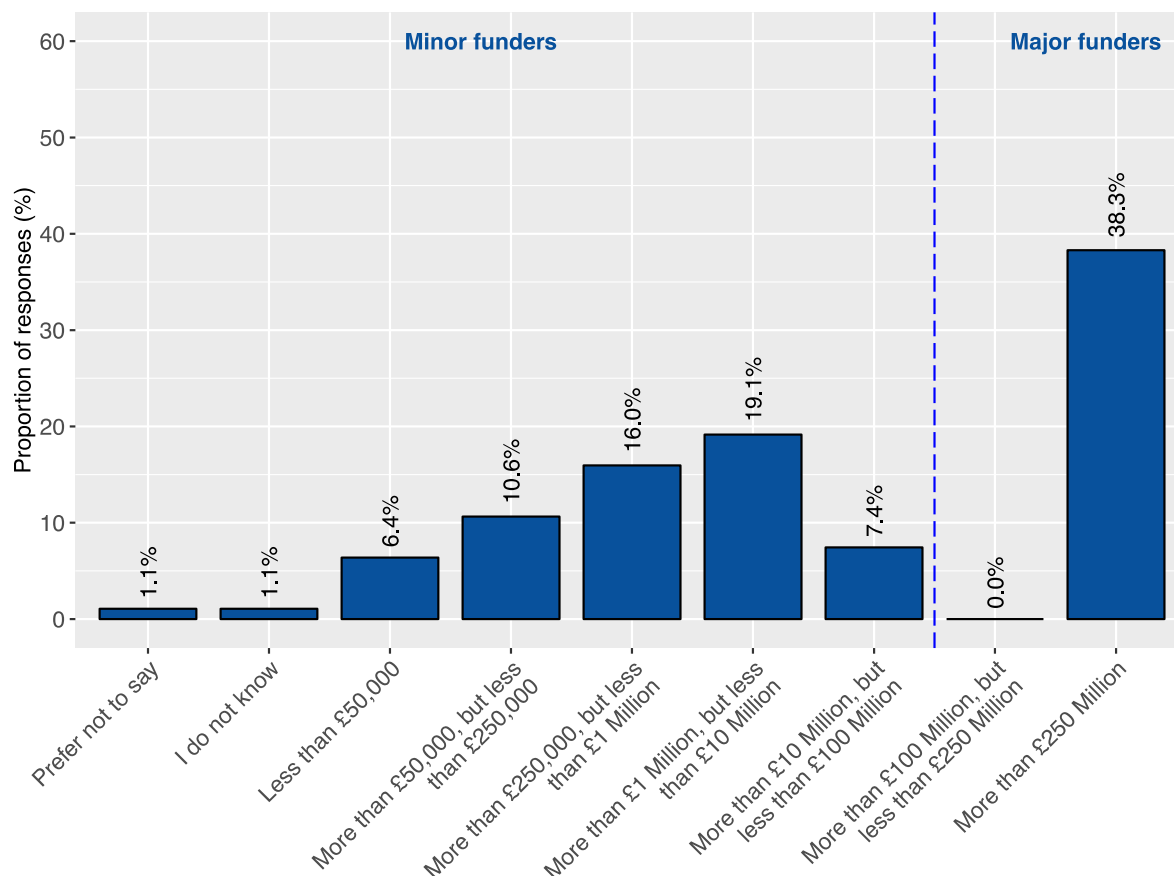


Figure 32 shows the job titles of respondents along with their distribution by type of funder, i.e. minor or major as defined in the previous section. The largest category of respondents was programme/portfolio managers (38%) followed by directors (20%) and officers (13%). Figure 32b shows that programme/portfolio managers are mostly from major funders (67% of respondents from major funders are within this category), while directors are mostly from minor funders (31% of the respondents from major funders are within this category). This is to be expected given the more extensive organisational structure that is likely to feature among major funders when compared to minor funders.

Given the lack of the national-level data on the population of research managers in funding organisations and their job titles, we could not identify bias related to job titles in our set of responses. For this reason, the analysis reported in the following sections has to be interpreted in light of the distribution of job titles reported.

Figure 32 Job titles of the respondents in the sample (a) and distribution of job titles by type of funder (b) (proportions <5% are not labelled)

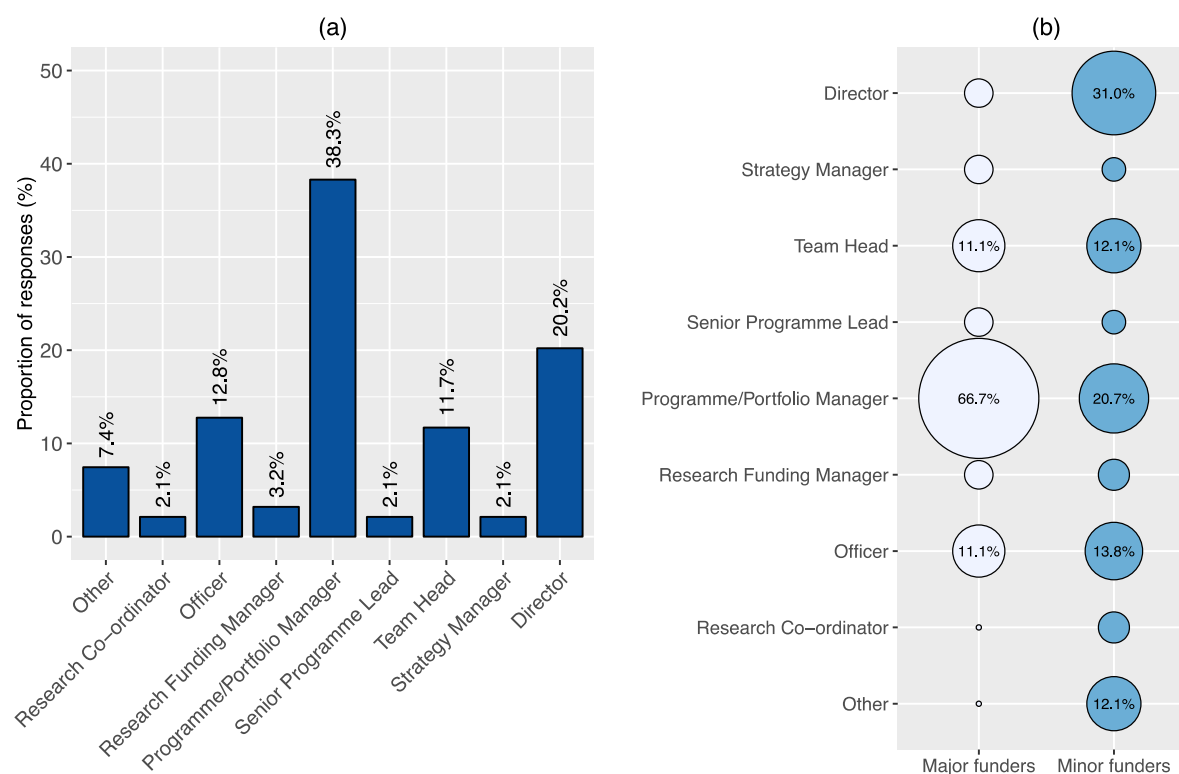
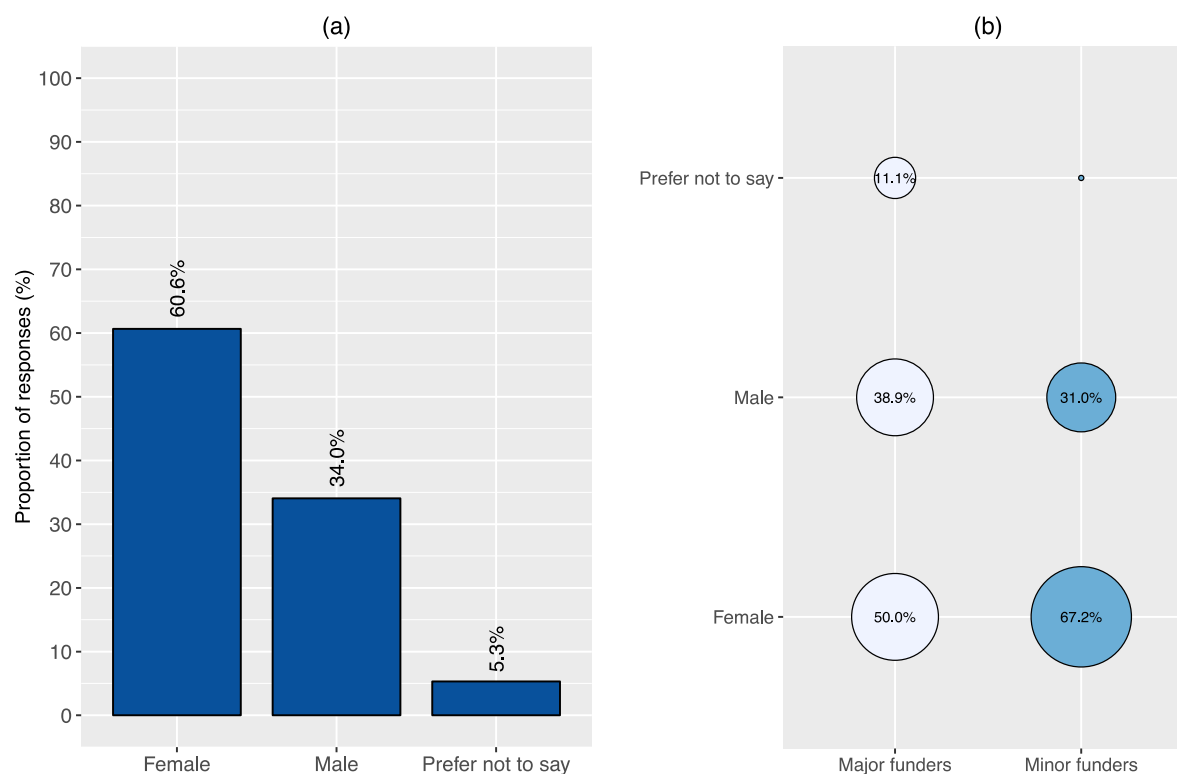


Figure 33 shows that the sample for the survey for funders is composed of 61% of female and 34% of male respondents. The remaining respondents (5%) preferred not to declare their gender. The proportion of female respondents is greater in minor funders (37%) than in major funders (50%). As in the case of job titles, given the lack of data on the population of research managers in funding organisations and their gender we could not identify bias related to job titles in our set of responses.

C.4.2 Results

The following sections analyse responses from managers in funding organisations on the perceived importance of IDR, involvement with IDR activities, as well as perceived and experienced barriers to and incentives for IDR. The analysis is based on a comparison between major funders and minor funders (as previously defined).

Figure 33 Respondents by gender (a) and by type of funder (b)

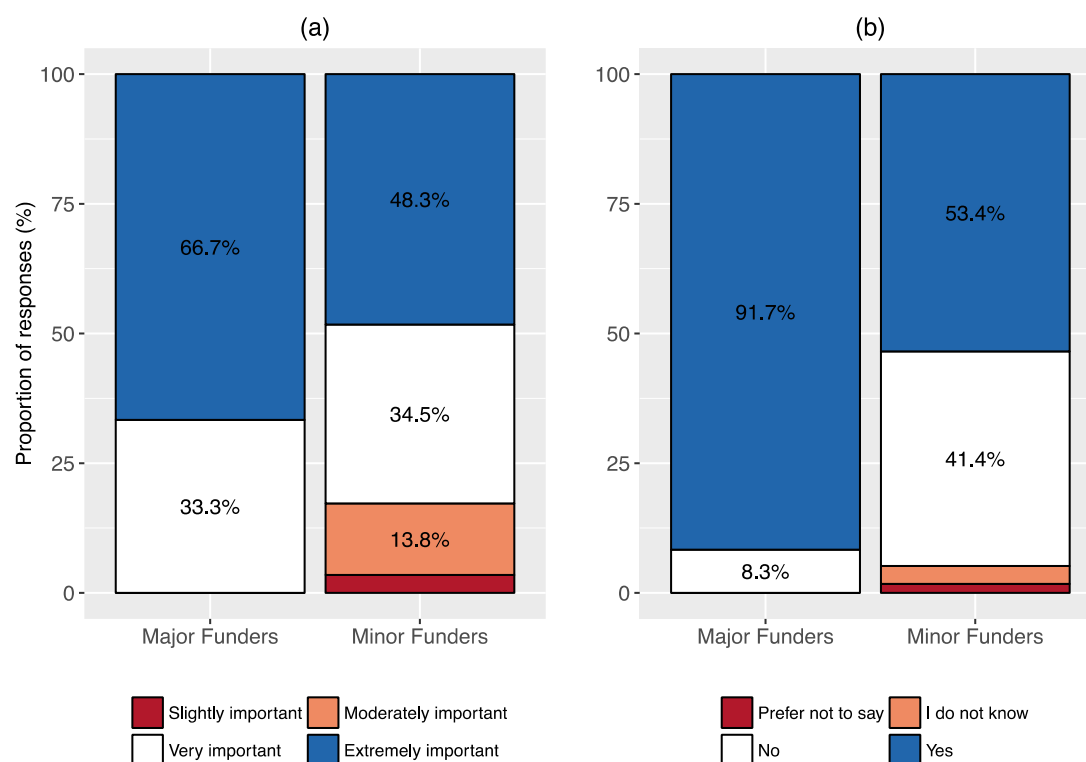


Importance of IDR

As a guide to the level of support for IDR, all respondents were asked to what extent they think IDR is important and whether IDR is a priority for their funding organisation.

Figure 34 shows the distribution of responses from major and minor funders. Respondents from major funders consider IDR more important than their colleagues in minor funders with all those at major funders seeing IDR as very important or extremely important compared to 83% in minor funders. The difference between the distribution of responses is statistically significant (*K-W test on distributions: $p < 0.05$*). Respondents from major funders were also significantly more likely to suggest that IDR was a priority for their organisations (92%) compared to minor funders (54%) (*K-W test on distributions: $p < 0.001$*).

Figure 34 Importance of IDR from (a) the respondent's own perspective and (b) their perception of whether IDR is a priority for their organisation (proportions <5% are not labelled)

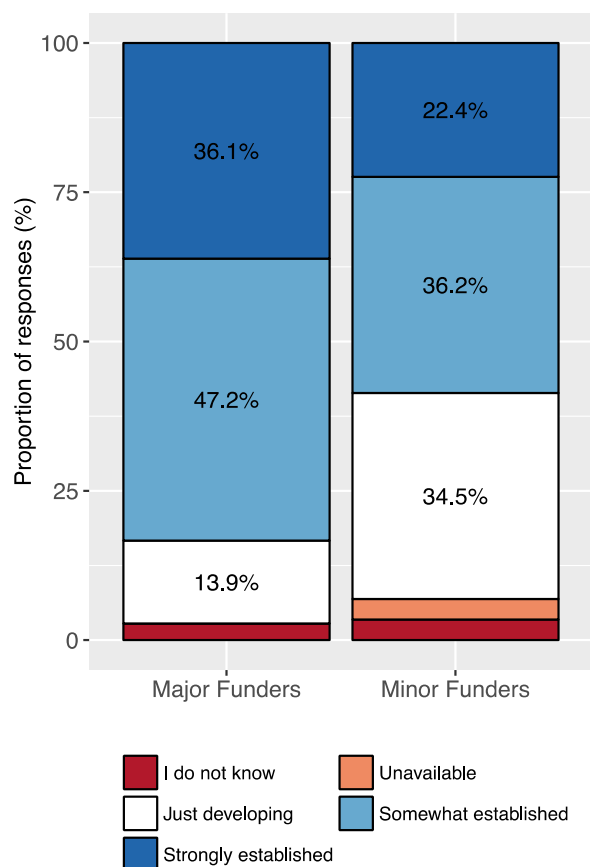


Support for IDR

Major and minor funders were asked to determine how developed support for IDR was in their funding organisation.

Figure 35 explores the results, which reveal a significant difference between the views of staff in the two groups. Among major funders 83% think that their funder has strongly established or somewhat established support for IDR, however this figure is a much lower 56% in smaller funders. The difference between the distributions of responses is significant (K-W test on distributions: $p < 0.05$).

Figure 35 Support for IDR is perceived as more developed in major funders than in minor funders (proportions <5% are not labelled).



Perceived barriers to IDR

A wide range of potential barriers to IDR are collected into the four categories presented in Figure 36. Following analysis of survey responses, a more detailed analysis of factors within each category will be explored in the following sections.

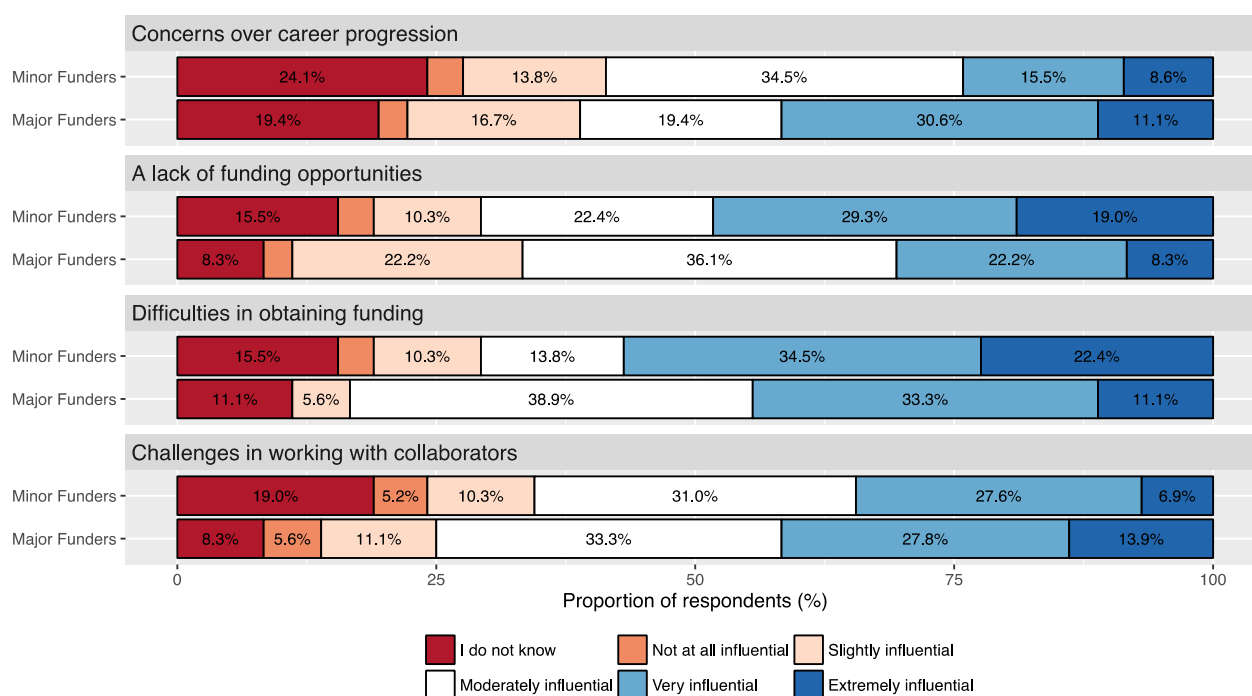
Major and minor funders both agree that career progression concerns are a barrier to IDR, with 78% of respondents from major funders and 72% of minor funders seeing such concerns as at least slightly influential, although only 42% of major funders and 24% of minor funders saw these concerns as extremely influential or very influential. 3% of funders from each group suggested these concerns were not influential at all.

The only area where funders had a significant difference in their views was over the proposition that a lack of funding opportunities was a barrier to IDR. Nearly 90% of respondents from major funders thought that this was influential to some extent, compared to 81% of respondents from minor funders. However more minor funders felt this issue was strongly influential or very influential (48%) compared to major funders (31%). Again, only 3% of respondents thought this issue was not at all influential.

Where funding opportunities exist, 90% of respondents from major funders and 81% of respondents from minor funders agreed that to some extent there were difficulties in obtaining funding for IDR. The proportion of minor funders seeing these issues as extremely influential or very influential was 57% compared to 44% for major funders – there is, however, no statistically significant difference between the distributions of the responses of the two groups.

Finally, on the issue of whether challenges in working with collaborators is a barrier to IDR, there is agreement from 86% of major funders and 75% of minor funders that these factors are at least slightly influential. More major funders than minor funders felt that these challenges were very or extremely influential (42% versus 35%). In both groups, only 5-6% of respondents felt that these factors were not influential.

Figure 36 Perceived barriers to IDR by type of funder (proportions <5% are not labelled)



IDR and career

The views of funders on the training, careers, and progression of interdisciplinary researchers are explored in *Figure 37*. Views of major and minor funders are compared and no significant differences are reported between these groups. However, substantial differences do exist within groups.

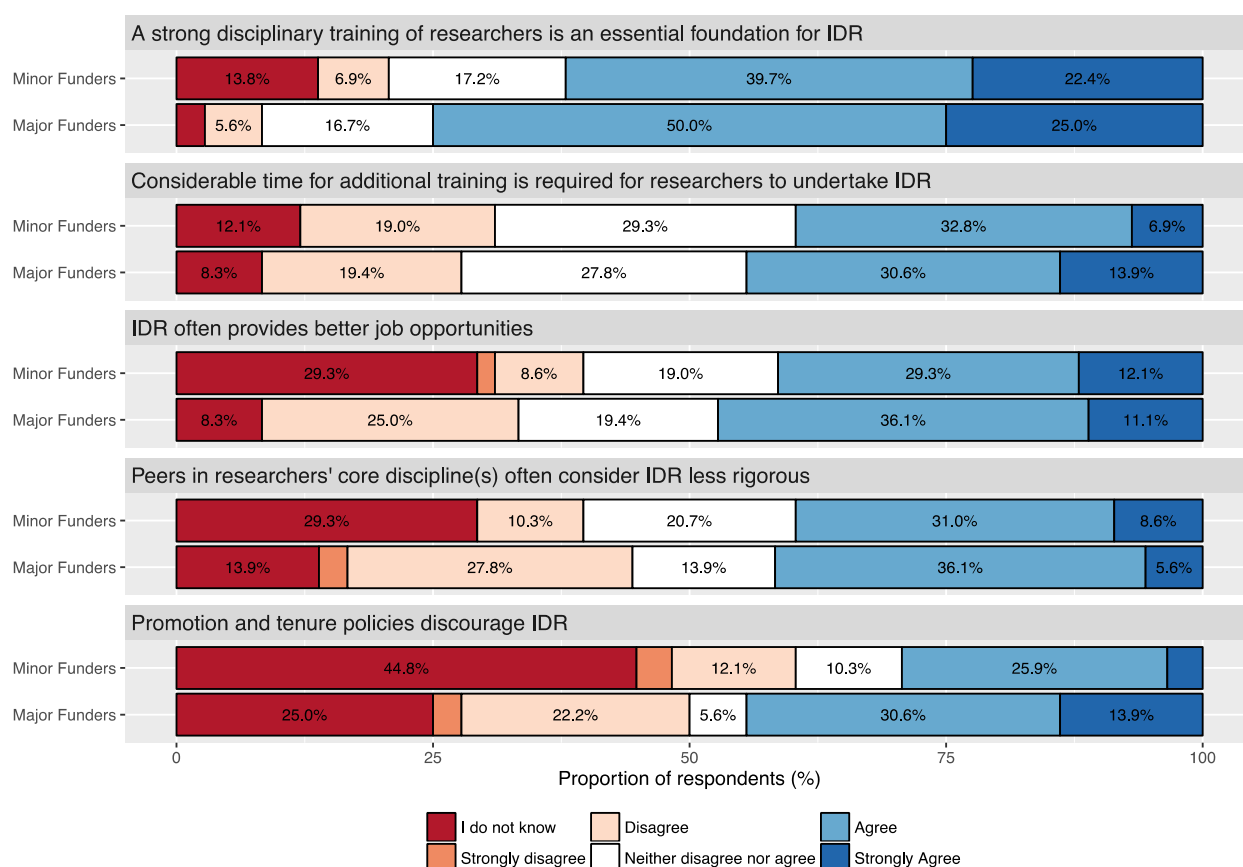
The proposition that a strong disciplinary training of researchers is an essential foundation for IDR is one that the vast majority of respondents support, with a few exceptions in both major and minor funders. Overall 75% of major funders and 62% of minor funders agreed or strongly agreed the proposition.

On the question of whether considerable time for additional training is required for researchers to undertake IDR, 45% of major funders and 40% of minor funders agreed or strongly agreed that this is the case. Less than half this number (19% in both groups) held the opposite view.

A similar pattern is seen when respondents were asked if IDR often provides better job opportunities. Here, 47% of major funders and 41% of minor funders agreed or strongly agreed with the proposition compared to 25% of major funders and 10% of minor funders that disagreed or strongly disagreed.

The proposition that peers in a researcher's core discipline(s) often consider IDR less rigorous split the major funders with 42% agreeing or strongly agreeing and 31% disagreeing or strongly disagreeing. Minor funders were less evenly divided. Those that had a firm view suggested that IDR would be seen as less rigorous by those in the core discipline (40% compared to only 10% that disagreed). However, many held a neutral view (21%) or did not know (29%).

Figure 37 IDR and career (proportions <5% are not labelled)



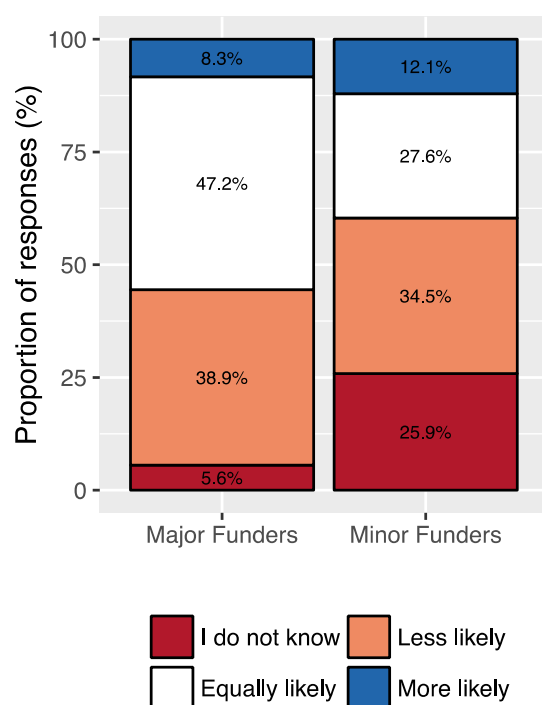
Finally, on the issue of whether promotion and tenure policies discourage IDR, many more respondents from major funders agreed or strongly agreed that tenure and promotion policies discouraged IDR (45% versus 25% who disagreed or strongly disagreed). Among the minor funders 29% agreed or strongly agreed with the proposition that these policies discouraged IDR, while less than half this number disagreed (14%). It is also notable that 45% of minor funders and 25% of major funders replied that they did not know – more than for any other question in this section.

Of the funding managers that responded in the free text box (n=11), a general sentiment was that it is difficult to generalise across all IDR because each project raises its own issues. Others were concerned that an increased focus on IDR would come at the expense of other academic aspects. One said “I am concerned about a trend away from cross-university disciplinary research. I've just had a researcher on the phone who said her organisation wouldn't support her to be a co-applicant on a proposal from another institution as ‘there was no benefit to the university’”.

IDR and funding

Funders were asked whether IDR was more likely, less likely, or equally likely to be funded compared to monodisciplinary research. *Figure 38* shows that respondents think IDR is not more likely to be funded than monodisciplinary research. Indeed, a substantial proportion of respondents think IDR is less likely to be funded, although many also think IDR is equally likely to be funded.

Figure 38 Likelihood of IDR to be funded



Managers in major funders were most likely to answer that IDR and monodisciplinary research were equally likely to be funded (47%), although a large minority saw IDR as less likely to be funded (39%) – this minority was nearly five times larger than the small minority that saw IDR as more likely to be funded (8%). Research managers at minor funders thought that IDR faced more difficulty in being funded, with the largest group of respondents (34%) suggesting that IDR was less likely to be funded. Just 12% thought the opposite. 28% of respondents from minor funders thought that IDR would be equally likely to be funded. All these differences between the two groups of funders were however not statistically significant.

The funders that felt that IDR was less likely to be funded were asked which factors contributed to this expected outcome. *Figure 39* explores the similarities and differences in respondents' views regarding the factors across major and minor funders. The numbers of respondents in the analysis is relatively small (14 respondents from major funders and 20 respondents from minor funders) and as a result statistically significant differences are reported only occasionally in the following section.

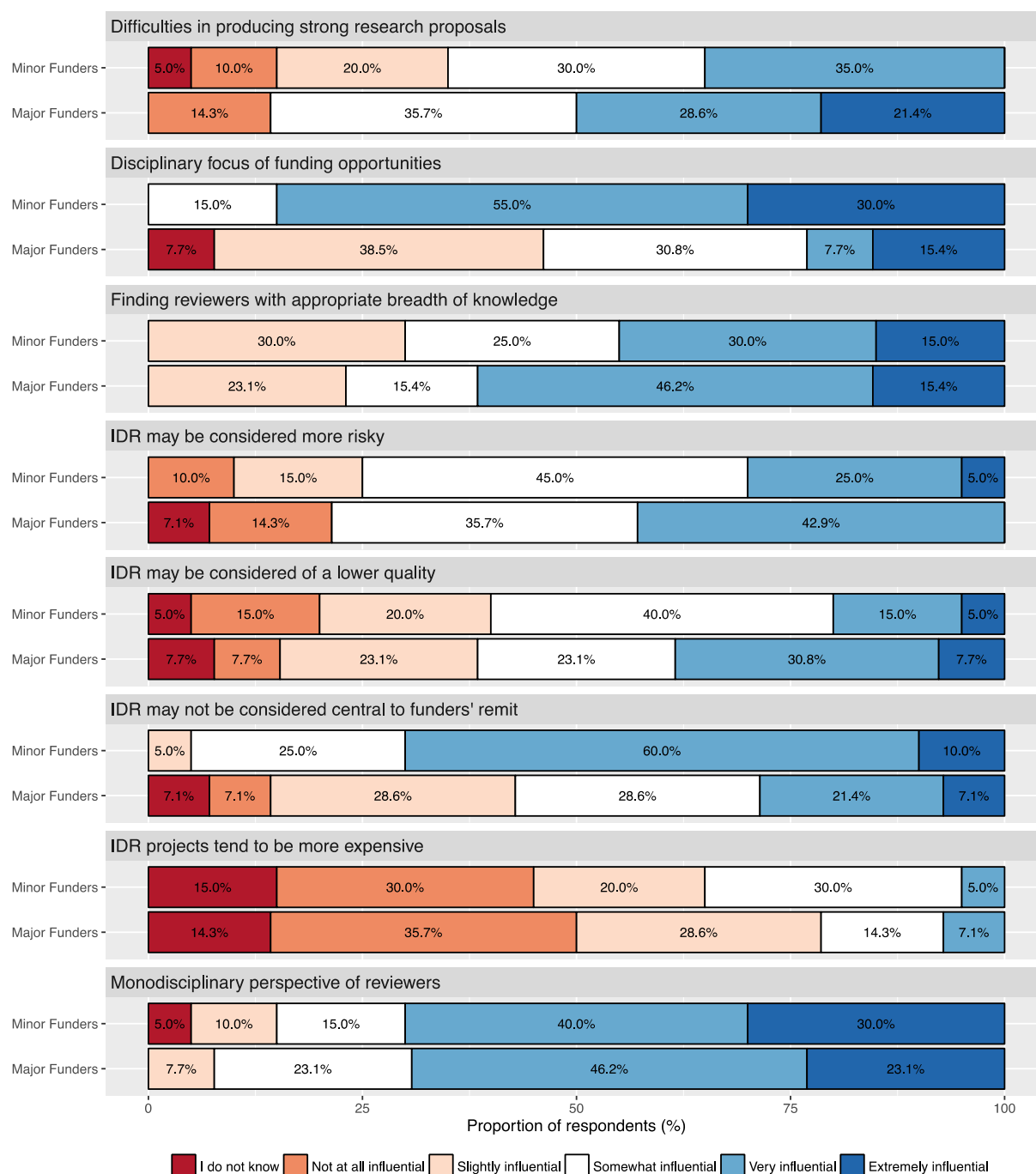
The vast majority of the funders (85% in the minor funders and 86% in the major funders) thought that greater difficulties in producing strong research proposals was influential at least to some extent in IDR being less likely to be funded. 50% of respondents from major funders and 35% of respondents from minor funders thought this was extremely or very influential. There was no statistically significant difference between the views of respondents from major and minor funder regarding this factor.

The disciplinary focus of funding opportunities was also seen as an influential factor in making IDR less likely to be funded, at least to some extent, by the vast majority of respondents – 92% of major funders and all minor funders. 85% of respondents from minor funders see this as extremely important or very important compared to 23% of those from major funders. The difference between the distributions of responses from major and minor funders is statistically significant (*K-W test on distributions: $p < 0.05$*).

There was also very strong support for the view that finding reviewers with an appropriate breadth of knowledge was an influential factor in hampering IDR. Importantly all respondents that thought IDR was less likely to be funded felt this was an influential factor to some extent. It was extremely or very influential to a greater extent among major funders than minor funders (62% against 45% respectively), although the difference was not statistically significant.

Similarly, the monodisciplinary perspective of reviewers was seen by all respondents from major funders and 95% of respondents from minor funders to be influential at least to some extent in IDR being less likely to be funded. 70% of respondents from minor funders and 69% of those from major funders felt that this was an extremely important or very important factor.

Figure 39 Factors that could contribute to IDR being less likely to be funded (proportions <5% are not labelled)



On the statement that IDR proposals were considered as lower quality, there was little difference between the overall proportion of funders seeing some influence of this factor (80% for minor funders and 85% for major funders) although nearly twice as many

respondents from major funders as minor funders thought that this factor was extremely or very influential (39% against 20%).

The vast majority of respondents who thought IDR was less likely to be funded saw funders' concerns that IDR might be more risky as an influential factor to some extent. This view was slightly more prevalent in minor funders (90%) than major funders (79%). Among major funders 43% of respondents saw this as very influential compared to 30% of respondents from minor funders, reflecting that minor funders were more polarised by this question (5% thought this factor was extremely influential, while no respondents from major funders did). There was no statistically significant difference between the two groups overall.

A factor that was seen as influential by the vast majority of those funders who were concerned that IDR was less likely to be funded was that IDR may not be seen as central to the funder's remit. All minor funders in the 'less likely to be funded' group saw this as influential to some extent, with 70% seeing this as extremely or very influential, compared to 29% of those at major funders that thought this factor was extremely or very influential. The difference between the distributions of responses of the two groups of funders is significant (*K-W test on distributions: $p < 0.05$*).

Finally, on the possibility that IDR projects may be less likely to be funded because they tend to be more expensive, 49% of major funders and 55% of minor funders saw this factor as influential to some extent, although no respondents saw this as extremely influential and most saw this as somewhat or slightly influential. A large minority in both major and minor funders (36% and 30% respectively) saw this factor as not influential at all – this constituted the highest proportion of respondents selecting 'not influential' for any factor in this set of questions.

Very few respondents thought that IDR was more likely to be funded than monodisciplinary research (just 3 respondents from major funders and 7 respondents from minor funders).

Figure 40 explores their support for the different contributory factors as to why IDR might be more likely to be funded. No statistical differences between major and minor funders were found, due to the small number of respondents holding this view.

Of the small minority that thought IDR was more likely to be funded, those from major funders were equally divided between those seeing this factor as extremely influential, slightly influential or 'I do not know' (33% for each) on the question of whether access to larger funding opportunities was a contributing factor. 86% of those at minor funders agreed that this was an influential factor to some extent, although a minority (14%) thought that this factor was not influential at all.

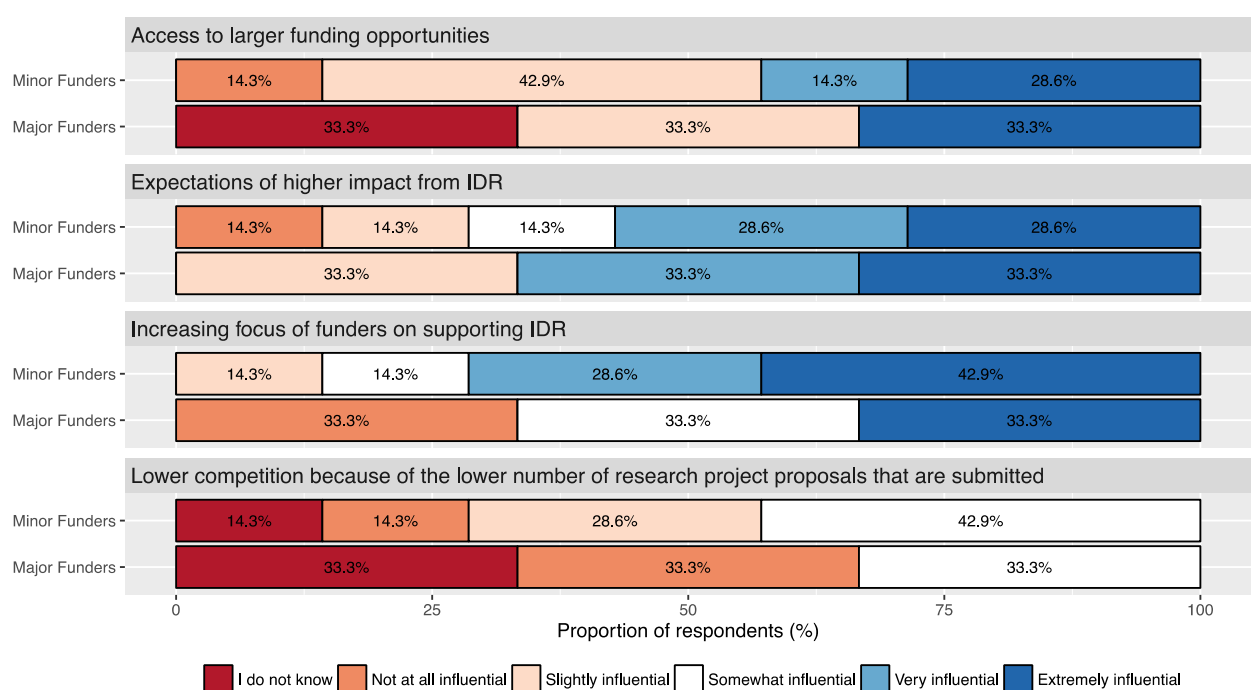
Almost all respondents supporting the view that IDR is more likely be funded agreed to some extent that expectations of higher impact from IDR were influential. Major funders were divided equally between seeing this as extremely influential, very influential, and slightly influential (33% each). Those from minor funders mostly (86%) perceived this was an influential factor with 57% seeing this as very or extremely influential.

Among the small minority that thought IDR was more likely to be funded, it was widely agreed that the increasing focus of funders on supporting IDR was a factor that made IDR more likely to be funded. All minor funders in this subset agreed to some extent, with a large majority seeing this as extremely influential or very influential (72%). Major funders were

split, with 33% respondents seeing this factor as extremely influential, somewhat influential or not influential at all.

Of the small minority that thought IDR was more likely to be funded, those from major funders showed no majority view on the extent to which lower competition because of fewer research project proposals being submitted was influential. They were instead equally divided between 'do not know', 'slightly influential' and 'not at all influential' (33% for each). The minor funders held more agreement than disagreement for this proposition, but as with the major funders, it was seen as slightly influential (29%) or somewhat influential (43%) rather than very influential or extremely influential. A smaller minority of minor funders saw this factor as not at all influential (14%).

Figure 40 IDR perceived as more likely to be funded (proportions <5% are not labelled)

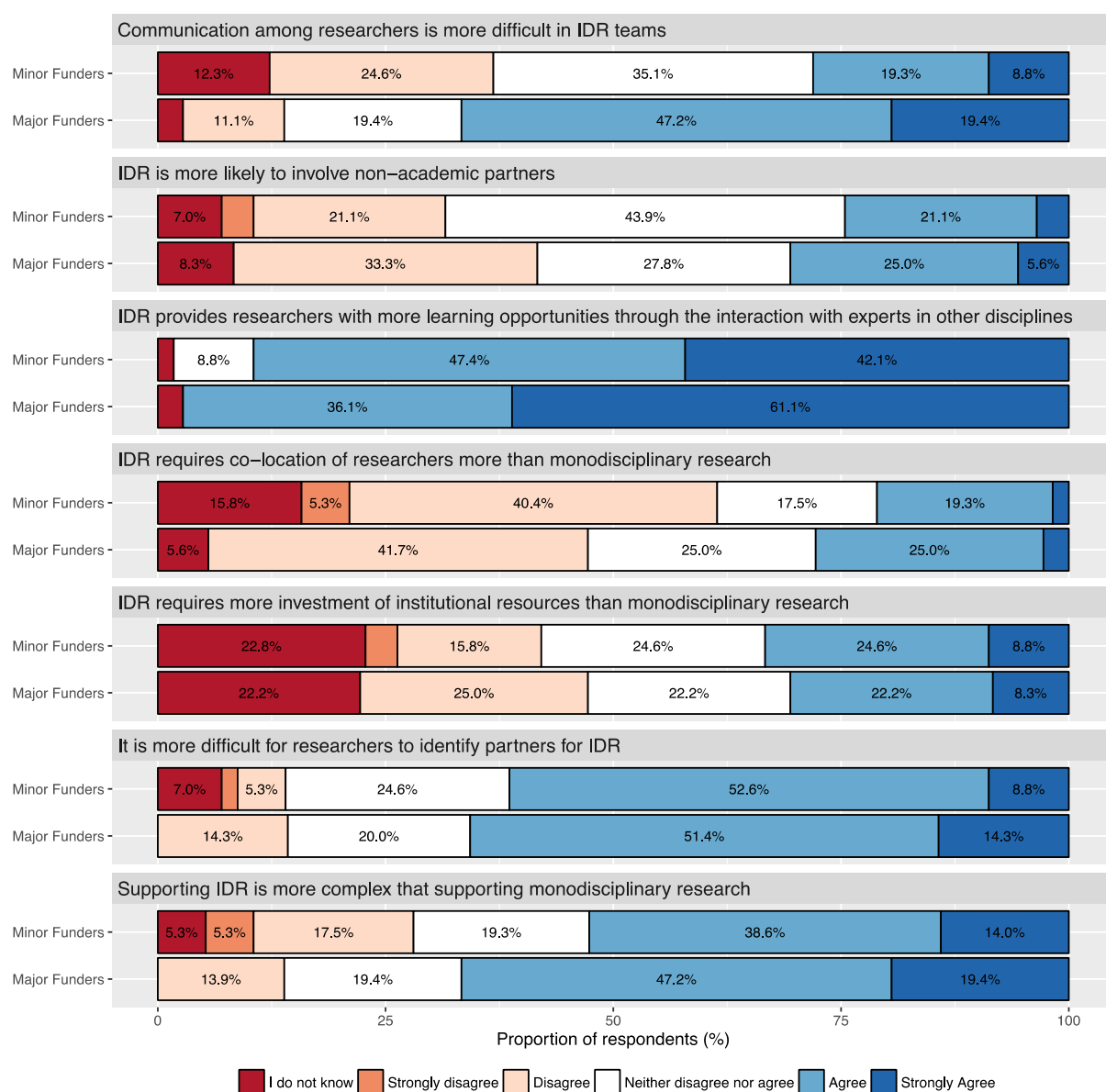


IDR and collaboration

The views of funders on the factors that may form barriers to or incentives for IDR that relate to research collaboration are in Figure 41. These results show areas of strong agreement and disagreement between major and minor funders.

There is strong disagreement between major and minor funders on the proposition that communication among researchers is more difficult in interdisciplinary teams. Two thirds of major funders agree or strongly agree with the proposition, six times as many as those opposing it (67% versus 11%). In contrast the highest proportion of respondents from minor funders are neutral, with a relatively even split between those agreeing or disagreeing with the proposition (28% against 25% respectively). The difference between the distributions of responses of major and minor funders is significant (*K-W test on distributions: $p < 0.01$*).

Figure 41 IDR and collaboration (proportions <5% are not labelled)



On the question of whether IDR is more likely to involve non-academic partners or not, there is no clear view from funders. Major and minor funders are divided, with as many neutral respondents. 33% of respondents from major funders disagreed that IDR was more likely to involve non-academic partners, slightly more than the 31% who agreed or strongly agreed. The most common view for the minor funders was the neutral position (49%) with an even split (25%) agreeing and disagreeing with the proposition. The differences between the distributions of responses were not marked enough to be statistically significant.

The proposition that IDR provides researchers with more learning opportunities through interaction with experts in other disciplines did not attract any disagreement. Significantly more respondents from major funders supported this view strongly than the equivalent in

minor funders (61% versus 42%), while overall 97% and 90% of major and minor funders respectively supported this proposition (*K-W test on distributions: $p < 0.05$*).

Most funders did not agree that IDR requires co-location of researchers more than monodisciplinary research. 42% of major funders and 46% of minor funders disagreed with this proposition, while only 28% of major funders and 21% of minor funders agreed that co-location was required for IDR. Significant differences between the two groups were not observed.

Only 31% of major funders and 33% of minor funders agreed or strongly agreed that IDR requires more institutional resources than monodisciplinary research, although this was slightly more than the 25% and 19% of respondents who disagreed or strongly disagreed. There was no significant difference between the groups.

A majority of both major (66%) and minor (61%) funders agreed with the proposition that it is more difficult to find partners for IDR. There was relatively little disagreement and no significant difference between the two groups of funders.

On the question of whether IDR was more complex to support than monodisciplinary research, a majority of respondents from the major and minor funders supported the proposition (67% and 53% respectively). Opposition to this view was 14% in the major funders and 23% in the minor funders.

IDR and outcomes

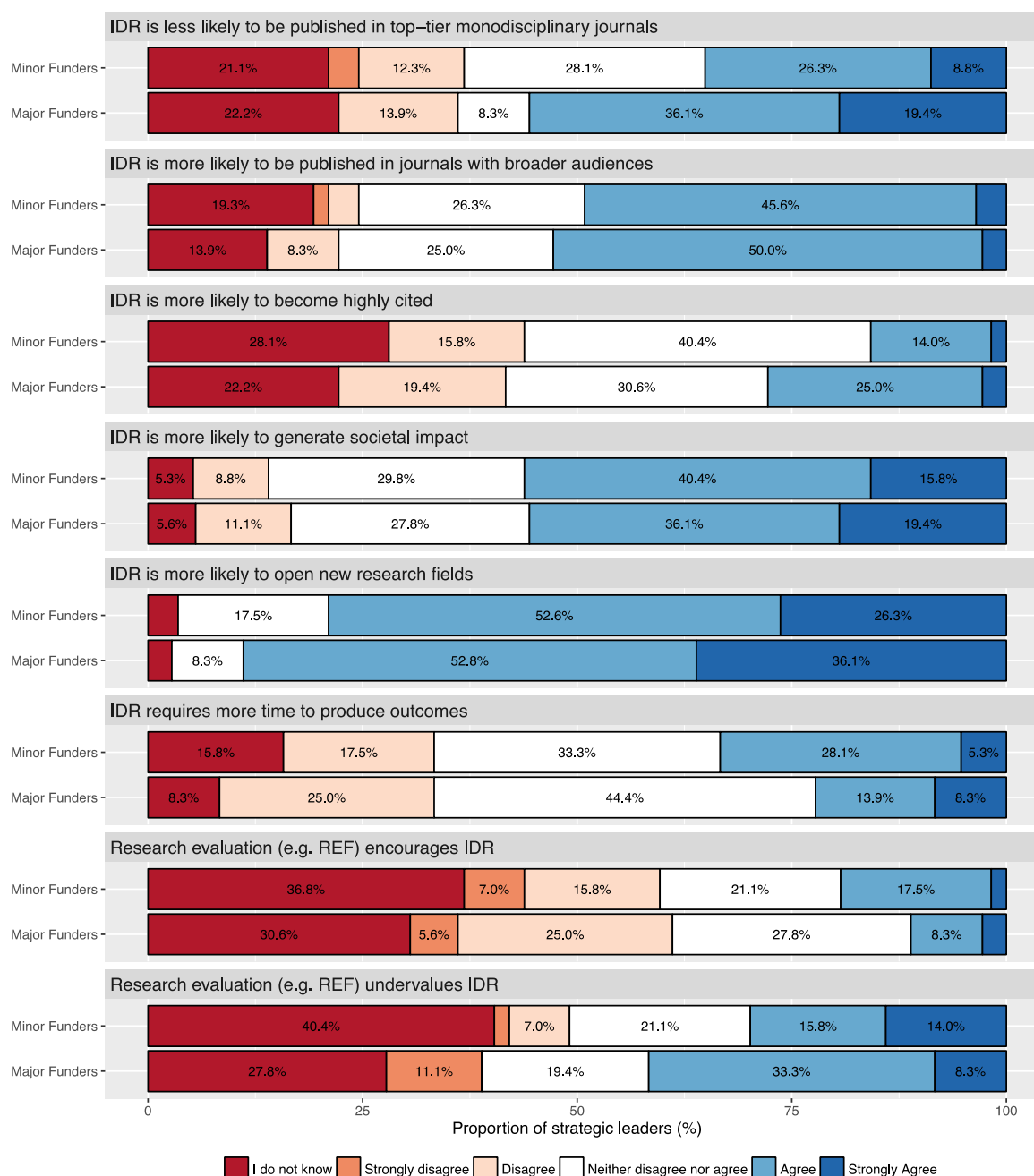
Funders were asked about the outcomes of IDR, including factors that could be barriers or incentives. The results were varied and are discussed factor by factor below.

There was a significant difference in the views of major and minor funders on the issue of whether IDR is less likely to be published in top-tier monodisciplinary journals. The majority of respondents from major funders supported the proposition (56%) compared to a lesser proportion from minor funders (35%). However, those that disagreed or strongly disagreed with the proposition were a much smaller proportion of both groups (*K-W test on distributions: $p < 0.05$*): 14% and 16% in major and minor funders, respectively.

In all other responses related to outcomes, there were no significant differences between the major and minor funder respondents. Again, this is likely to be due to the relatively small number of survey responses relevant to this section.

53% of major funders and 49% of minor funders agreed or strongly agreed with the proposition that IDR is more likely to be published in journals with broader audiences. Those in disagreement or strongly disagreement made up 8% of the major funders' respondents and 5% of minor funders' respondents.

Figure 42 IDR and research outcomes (proportions <5% are not labelled)



On the question of whether IDR is more likely to become highly cited than monodisciplinary research, the largest proportion of respondents had a neutral view (40% for minor funders and 31% for major funders). The minority of those supporting the proposition was slightly larger in the major funders than the minor funders. While the major funders showed slightly more support for the proposition that IDR is more likely to be highly cited, there was no clear view from the minor funders.

There was support at major and minor funders for the proposition that IDR is more likely to generate societal impact with 56% in both groups agreeing or strongly agreeing against only 11% of major funders and 9% of minor funders showing disagreement, and none showing strong disagreement.

There was no opposition to the proposition that IDR is more likely to open new research fields, with 90% and 79% of respondents from major and minor funders respectively agreeing or strongly agreeing with the proposition.

Major and minor funders seem to disagree on whether IDR requires more time to produce outcomes. Major funders were more likely to be neutral (44%), with a smaller minority (22%) agreeing or strongly agreeing that IDR takes longer to produce outcomes compared to those disagreeing (25%). The results from minor funders showed the opposite distribution, with an equal number of respondents supporting the view that IDR needs more time to produce outcomes compared to those with a neutral stance (one third of respondents each), and around half as many disagreeing (18%). However, the differences between the distributions of responses are not statistically significant.

Major funders were nearly three times more likely to disagree or strongly disagree with the proposition that research evaluation encourages IDR than to agree (31% versus 11%), although 28% of respondents were neutral. However, minor funders were more evenly split between supporting and opposing the proposition and adopting the neutral stance (23% and 21% respectively). A notably large proportion of both groups (31% for major funders and 37% for minor funders) responded that they did not know.

Both major and minor funders were more likely to agree or strongly agree with the proposition that research evaluation undervalues IDR than to oppose it (42% for major funders and 30% for minor funders in support compared to 11% and 9% that opposed the proposition respectively). For the major funders, although nearly four times more respondents agreed that IDR is undervalued, it is notable that all the opposing respondents took the 'strongly disagree' stance.

Of the few comments received for this question (n=6), the overriding theme was that funding managers did not have the experience to answer some questions confidently: "I don't have direct experience to draw on – our researchers clearly believe it's hard to get [IDR] valued by peers, and published" and "[m]ore likely to be cited: we would hope so, but I'm not sure if it actually happens".

C.5 References

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Sauermann, H., & Roach, M. (2013). Increasing web survey response rates in innovation research: An experimental study of static and dynamic contact design features. *Research Policy*, 42(1), 273–286. doi:10.1016/j.respol.2012.05.003

Appendix D Interview Template

C.6 QUESTIONS FOR FUNDERS

Question 1: What is your job title and how long have you been in your current role?

Question 2: How does your role relate to interdisciplinary research (IDR)?

Question 3: How would you define interdisciplinary, multidisciplinary, cross-disciplinary or transdisciplinary research?

Prompt: Is there a difference between these approaches?

Question 4: Why does your organisation support IDR?

Question 5: What in your opinion drives IDR activity in general?

Prompt: Please provide evidence/examples

Question 6: How does IDR feature in HE research policies?

Prompt: How do HE research policies affect IDR? Please provide evidence/examples

Question 7: Do you think incentives are required to facilitate and stimulate IDR? Why?

Prompt: Please provide evidence/examples of effective strategies

Question 8: How does your organisation support IDR?

Prompt: infrastructure, projects, culture - Please provide evidence/examples

Question 9: Do you fund IDR? What mechanism do you use?

Prompt: Do you fund particular disciplines?

Prompt: Please comment on the impact of funding remits on the support of IDR

Prompt: How does IDR access funding through your organisation? (*specific streams, general call, block grant allocations*)

Question 10: How does the volume of IDR submitted to your funding process compare to monodisciplinary research?

Prompt: please comment on all streams (*specific streams, general call, block grant allocations*)

Question 11: How is IDR assessed by your organisation?

Prompt: peer review, review panels or other mechanisms

Prompt: how do you account for IDR within your assessment approach- i.e. how do you ensure you have access to all the relevant expertise

Question 12: What are the challenges of assessing IDR?

Prompt: Quality, impact, funding, reviewer expertise

Prompt: 'do you think researchers are less likely to submit IDR proposals/ research outputs? If so, why?'

Question 13: Are there barriers to undertaking IDR in UK HE?

Prompt: What are the barriers? Please provide examples.

Question 14: How should these barriers be addressed?

Prompt: Please provide examples of any measures taken by your organisation.

Question 15: What is the role of collaboration in IDR?

Prompt: Please consider collaboration with external non-HE partners in particular.

Question 16: What are your thoughts on the current status of IDR in the UK?

Prompt: Please consider volume and quality and evidence where possible.

Question 17: What might IDR in the UK look like in the future?

Prompt: Why?

Question 16: Further comments

C.7 QUESTIONS FOR STRATEGIC LEADERS

Question 1: What is your job title and how long have you been in your current role?

Question 2: How does your role relate to interdisciplinary research (IDR)?

Question 3: How would you define interdisciplinary, multidisciplinary, cross-disciplinary or transdisciplinary research?

Prompt: Is there a difference between these approaches?

Question 4: What is the motivation for HE institutions to encourage and support IDR?

Prompt: Why does your organisation support IDR?

Question 5: What in your opinion drives IDR activity in general?

Prompt: Please provide evidence/examples

Question 6: How do national HE research policies affect IDR at an institutional level?

Prompt: Please provide evidence/examples

Question 7: What is the role of IDR in your institution?

Prompt: How strongly does it feature in the overall research portfolio?

Prompt: Does IDR feature in your institutional strategies (Research/Knowledge Exchange/Innovation)

Question 8: How does your institution support IDR?

Prompt: funding, policies, culture, infrastructure

Prompt: examples, evidence

Question 9: Is further support required from your institution for IDR?

Prompt: funding, policies, culture, infrastructure

Prompt: Level- central management, department, institute, research group

Question 10: How and why do institutional and/or departmental cultures affect IDR?

Prompt: Please comment on organisational structure, career progression, academic culture.

Question 11: What is the role of collaboration with external non-HE partners in IDR?

Prompt: Please provide examples if any of how your organisation has boosted and supported such collaborations.

Question 12: How does the assessment of IDR for quality and funding affect IDR?

Prompt: A recent project, using a citation- based approach, suggested that proportionally less IDR than expected was submitted to the REF. What factors do you feel may have contributed to this?

Question 13: Are there any general barriers/disincentives that dissuade researchers from conducting IDR at your institution?

Prompt: Please consider internal and external barriers at all levels, including in the UK HE system.

Question 14: What are your thoughts on the current status of IDR in the UK?

Prompt: Please consider volume and quality and evidence where possible.

Question 15: What might IDR in the UK look like in the future?

Prompt: Why?

Question 16: Further comments

C.8 QUESTIONS FOR RESEARCHERS

Question 1: What is your job title and how long have you been in your current role?

Question 2: What experience do you have in IDR?

Prompt: How long has it been?

Prompt: What is your disciplinary background?

Prompt: What disciplines does your research combine?

Prompt: What proportion of your research is IDR? How much time do you spend conducting IDR?

Prompt: Did you undertake any special training for IDR?

Question 3: How do you identify yourself as a researcher?

Prompt: Are you an interdisciplinary, multidisciplinary, cross-disciplinary or transdisciplinary researcher?

Prompt: Is there a difference?

Question 4: Why do you conduct IDR?

Question 5: What is the role of IDR in HE research policies? How do HE research policies affect IDR?

Prompt: Please provide examples/evidence

Question 6: How effectively do you feel IDR is supported in the UK?

Prompt: Funding, infrastructure, policies, publication, career structures

Prompt: Please provide examples/evidence

Question 7: How effectively do you feel IDR is supported at your institution?

Prompt: Funding, infrastructure, policies, publication, career progression

Prompt: Please provide examples/evidence

Question 8: How do institutional and departmental cultures affect IDR?

Prompt: Please provide examples/evidence

Question 10: How do cultures within disciplinary groups/wider academia affect IDR?

Prompt: Please provide examples/evidence

Question 11: What are your experiences of publishing IDR?

Prompt: publishing culture, peer review, citation impact

Question 12: How should researchers be trained?

Prompt: Should it be monodisciplinary or interdisciplinary?

Question 13: How should IDR fit within a research career? How does IDR fit within a research career?

Question 14: What is the role of collaboration and team working in IDR?

Prompt: Please comment on networking and building interdisciplinary teams, especially with non-HE partners.

Prompt: Please also talk about managing differences in norms, expectations, and language.

Question 15: What is the role of leadership in IDR?

Prompt: Please comment on leadership styles and the attributes of a good leader.

Question 16: Did you submit any interdisciplinary outputs to REF 2014?

Prompt: A recent project, using a citation-based approach, suggested that proportionally less IDR than expected was submitted to the REF reflecting on your experience what factors do you feel might contribute to this?

Question 17: Are there any other general barriers/disincentives in UK HE that dissuade people from conducting IDR?

Prompt: What are the barriers? Please provide examples.

Prompt: Which barriers have you personally experienced?

Question 18: Would you undertake IDR again? Why? Would you do anything differently?

Question 19: What are your thoughts on the current status of IDR in the UK?

Prompt: Please consider volume and quality and evidence where possible.

Question 20: What might IDR in the UK look like in the future?

Prompt: Why?

Question 21: Further comments

Appendix E Survey Questionnaires

C.9 FOR RESEARCHERS

Dear Researcher, You are invited to take part in a short on-line survey (of 10-15 minutes) on "Barriers to and incentives for interdisciplinary research in the UK". This survey has been commissioned by the Higher Education Funding Council for England (HEFCE) and the Medical Research Council (MRC). The Science Policy Research Unit (SPRU) at the University of Sussex is administering the survey. The primary purpose of the survey is to provide an understanding of the extent to which researchers in the UK perceive barriers to and incentives for interdisciplinary research and how these influence their research activities. The survey has been designed for researchers based in the UK and working in any discipline including those who regard their work as interdisciplinary and those who do not. Participation in this survey is voluntary. Please find here a letter of support from HEFCE and MRC, encouraging researchers' participation. All responses will be anonymised (please avoid including references that identify yourself or others in the free text responses). The findings of the survey will be reported publicly and used to inform policy debate. Further information on the survey, data use and protection is available as Additional Information about the Survey. Before you decide to participate, please confirm that you have been adequately informed about the survey and agree with the following statements: I confirm that I have read and understand the information above. I understand that my anonymous response will be used for research and to inform policy debate. I consent to the use of my anonymous response for the above purposes.

- ☐ Agree
- ☐ Disagree
- ☐ I am not involved with research activities

What types of research does the term 'interdisciplinary' include? In this survey, we use the term interdisciplinary research to refer to all research activities that cross disciplinary boundaries (in contrast to monodisciplinary research). These include research activities that are often described as multidisciplinary, transdisciplinary, and crossdisciplinary as well as interdisciplinary.

To what extent do you consider interdisciplinary research important?

- ☐ Extremely important
- ☐ Very important
- ☐ Moderately important
- ☐ Slightly important
- ☐ Not at all important
- ☐ I do not know

When did you last undertake interdisciplinary research?

- ☐ Within the last three years

- ☐ More than three years ago
- ☐ I have not undertaken interdisciplinary research
- ☐ I do not know

Are you planning to undertake interdisciplinary research?

- ☐ Yes
- ☐ Maybe
- ☐ No

Please select at least two subject areas that your interdisciplinary research in the last three years has involved.

[The subject classification is based on the Thomson Reuters Web of Science Subject Areas. If this classification is not appropriate to describe your interdisciplinary research in the last three years, please provide the names of at least two subject areas below.]

To what extent do the following factors influence you when considering whether to undertake interdisciplinary research?

| | Not at all influential | Slightly influential | Moderately influential | Very influential | Extremely influential | I do not know |
|---|---------------------------|-------------------------|---------------------------|-----------------------|--------------------------|-----------------------|
| Concerns over career progression | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Difficulties in obtaining funding | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Challenges in working with collaborators | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Difficulties in publishing | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is not a priority for me | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| A lack of funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

C.9.1 Interdisciplinary research and career

On the basis of your experience in the UK, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Promotion and tenure policies discourage interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research often provides better job opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Considerable time for additional training is required to undertake interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| A strong disciplinary training is an essential foundation for interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Peers in my core discipline(s) often consider interdisciplinary research less rigorous | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on the above statements please report these below.

C.9.2 *Interdisciplinary research and funding*

In your opinion, is interdisciplinary research more or less likely to be funded than monodisciplinary research in the UK?

- ☐ Less likely
- ☐ Equally likely
- ☐ More likely
- ☐ I do not know

On the basis of your experience in the UK, please indicate the extent to which the following factors make interdisciplinary research less likely to be funded than monodisciplinary research.

| | Not at all influential | Slightly influential | Somewhat influential | Very influential | Extremely influential | I do not know |
|---|---------------------------|-------------------------|-------------------------|-----------------------|--------------------------|-----------------------|
| Monodisciplinary perspective of reviewers | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research may be considered more risky | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research may be considered of a lower quality | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Difficulties in producing strong research proposals | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Disciplinary focus of funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on factors that may affect the likelihood of obtaining funding for interdisciplinary research, please report these below.

On the basis of your experience in the UK, please indicate the extent to which the following factors make interdisciplinary research more likely to be funded than monodisciplinary research.

| | Not at all influential | Slightly influential | Somewhat influential | Very influential | Extremely influential | I do not know |
|--|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Increasing focus of Funders on supporting interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Lower competition because of the lower number of research project proposals that are submitted | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Expectations of higher impact from interdisciplinary research projects | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Access to larger funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on factors that may affect the likelihood of obtaining funding for interdisciplinary research, please report these below.

How much external research funding have you been awarded in the last three years (i.e. for research projects on which you have been Principal Investigator or Co-Investigator)?

- ☐ None
- ☐ Less than £50,000
- ☐ £50,000 - £249,000
- ☐ £250,000 - £999,000
- ☐ £1,000,000 - £10,000,000
- ☐ More than £10,000,000

☐ I do not know

**Which have been the main sources that have contributed to this research funding?
(multiple options can be selected)**

- ☐ Funding from within your institution
- ☐ UK Research Councils
- ☐ UK Government
- ☐ UK Charities/Trusts/Foundations
- ☐ European Commission
- ☐ National governments outside the UK
- ☐ National research councils outside the UK
- ☐ Charities/Trusts/Foundations outside the UK
- ☐ Industry
- ☐ Other (please specify) _____

Which of these sources of funding have supported your disciplinary and/or interdisciplinary research?

C.9.3 *Interdisciplinary research and collaboration*

On the basis of your experience in the UK, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Interdisciplinary research provides more learning opportunities through the interaction with experts in other disciplines | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| It is more difficult to identify partners for interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research requires the involvement of disciplines that are less rigorous than my core discipline(s) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Communication is more difficult in interdisciplinary teams | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research requires co-location of researchers more than monodisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to involve non-academic partners | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on the above statements please report these below.

Do you undertake interdisciplinary research individually or in teams?

- ☐ Individually
- ☐ In teams
- ☐ Individually and in teams

What is the average size of the interdisciplinary teams with which you are involved?

- ☐ Less than 3 members
- ☐ From 3 to 5 members
- ☐ From 6 to 8 members
- ☐ From 8 to 10 members
- ☐ More than 10 members

C.9.4 Interdisciplinary research and outcomes

On the basis of your experience in the UK, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Interdisciplinary research is academically rigorous | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is less likely to be published in top-tier journals in my core discipline(s) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to be published in journals with broader audiences | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Interdisciplinary research is more likely to become highly cited | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Research evaluation (e.g. REF) encourages interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Research evaluation (e.g. REF) undervalues interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to generate societal impact | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to open new research fields | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research requires more time to produce outcomes | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on the above statements please report these below.

What is your job title?

- ☐ Professor
- ☐ Emeritus Professor
- ☐ Reader
- ☐ Emeritus Reader
- ☐ Associate Professor
- ☐ Senior Lecturer/Principal Lecturer
- ☐ Lecturer

- ☐ Assistant Professor
- ☐ Senior Research Fellow
- ☐ Research Fellow
- ☐ Senior Teaching Fellow
- ☐ Teaching Fellow
- ☐ Postdoc
- ☐ Research Associate
- ☐ PhD Candidate
- ☐ Research Assistant
- ☐ Other academic position _____
- ☐ Other non-academic position _____

Your position is ...

- ☐ full-time (open-ended/permanent)
- ☐ full-time (fixed-term)
- ☐ full-time
- ☐ part-time (open-ended/permanent)
- ☐ part-time (fixed-term)
- ☐ part-time

Please indicate the percentage of your part-time position

_____ % Full-time equivalent (FTE)

What percentage of your time is allocated to research?

_____ Percentage (%)

**Do the duties of your position include any of the following management roles?
(multiple options can be selected)**

- ☐ Principal or Co-Investigator on Grants
- ☐ Subject Lead
- ☐ Head* of Faculty
- ☐ Head* of School

- ☐ Head* of Department
- ☐ Deputy Director** of Faculty
- ☐ Deputy Director** of School
- ☐ Deputy Director** of Department
- ☐ Head* of Institute
- ☐ Head* of Research Centre
- ☐ Head* of Academic Unit (or Research Group)
- ☐ Head* of Programme
- ☐ Head* of Research of Faculty
- ☐ Head* of Research of School
- ☐ Head* of Research of Department
- ☐ Head* of Teaching of Faculty
- ☐ Head* of Teaching of School
- ☐ Head* of Teaching of Department
- ☐ Head* of Doctoral Studies of Faculty
- ☐ Head* of Doctoral Studies of School
- ☐ Head* of Doctoral Studies of Department
- ☐ Head* of a Unit of Assessment (REF2014)
- ☐ Head* of a Unit of Assessment (next REF)
- ☐ Vice Chancellor
- ☐ Pro-Vice Chancellor
- ☐ Other roles (please specify below) _____

*or Dean, Director, Lead, or similar**or Associate Dean, Associate Head, Co-Director, Co-Lead, or similar

When were you appointed to your first academic post?

- ☐ Before April 2011
- ☐ After April 2011

Please indicate the percentage of your time that you spend leading research where

you determine the topic and design.

_____ Percentage (%)

For how many years have you been conducting research (excluding, if any, time spent on your PhD)?

- ☐ Between 6 and 10 years
- ☐ Between 11 and 15 years
- ☐ Between 16 and 20 years
- ☐ Between 21 and 25 years
- ☐ Between 26 and 30 years
- ☐ More than 30 years
- ☐ Prefer not to say

Were you submitted to the last UK Research Excellence Framework (REF)?

- ☐ Yes
- ☐ No
- ☐ Prefer not to say
- ☐ I do not know

Which REF Unit of Assessment were you submitted to?

- ☐ Agriculture, Veterinary and Food Science
- ☐ Allied Health Professions, Dentistry, Nursing and Pharmacy
- ☐ Biological Sciences
- ☐ Clinical Medicine
- ☐ Psychology, Psychiatry and Neuroscience
- ☐ Public Health, Health Services and Primary Care
- ☐ Aeronautical, Mechanical, Chemical and Manufacturing Engineering
- ☐ Chemistry
- ☐ Civil and Construction Engineering
- ☐ Computer Science and Informatics
- ☐ Earth Systems and Environmental Sciences

- ☐ Electrical and Electronic Engineering, Metallurgy and Materials
- ☐ General Engineering
- ☐ Mathematical Sciences
- ☐ Physics
- ☐ Anthropology and Development Studies
- ☐ Architecture, Built Environment and Planning
- ☐ Business and Management Studies
- ☐ Economics and Econometrics
- ☐ Education
- ☐ Geography, Environmental Studies and Archaeology
- ☐ Law
- ☐ Politics and International Studies
- ☐ Social Work and Social Policy
- ☐ Sociology
- ☐ Sport and Exercise Sciences, Leisure and Tourism
- ☐ Area Studies
- ☐ Art and Design: History, Practice and Theory
- ☐ Classics
- ☐ Communication, Cultural and Media Studies, Library and Information Management
- ☐ English Language and Literature
- ☐ History
- ☐ Modern Languages and Linguistics
- ☐ Music, Drama, Dance and Performing Arts
- ☐ Philosophy
- ☐ Theology and Religious Studies
- ☐ I do not know

Please indicate the main reason your institution/department did not include you in a submission to the last REF. (multiple options can be selected)

- ☐ I recently joined academia
- ☐ Insufficient 'REFable' outputs
- ☐ My research was difficult to align with my university's submission
- ☐ I am mostly focussed on teaching activities
- ☐ Prefer not to say
- ☐ I do not know
- ☐ Other (please specify below) _____

Please indicate the areas in which you have completed training. (multiple options can be selected)

| | Agriculture and forestry | Arts, humanities and social sciences | Modern foreign languages | Science, Technology, Engineering, and Mathematics | Clinical subjects | Other |
|---|--------------------------|--------------------------------------|--------------------------|---|--------------------------|--------------------------|
| Undergraduate degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Postgraduate degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Doctoral level degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other qualifications (please specify below) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

C.9.5 Demographic data

What is your age?

- ☐ Below 30
- ☐ 30 to 39
- ☐ 40 to 49
- ☐ 50 to 59
- ☐ 60 and over

- ☐ Prefer not to say

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

What is your nationality?

Please mention further nationalities if applicable.

Please help us to ensure that PhD candidates and Post-Doc researchers are not underrepresented in this survey. We would be grateful if you can provide us with up to five e-mail addresses of suitable individuals (PhD students or Post-Docs not directly supervised can be also nominated; more information on how e-mail addresses will be used is available as Additional Information about the Survey)

Do you have any other comment or recommendation on the topic of the survey?

C.10 FOR INSTITUTIONS

You are invited to take part in a short on-line survey (of 10-15 minutes) on "Barriers to and incentives for interdisciplinary research in the UK". This survey has been commissioned by the Higher Education Funding Council for England (HEFCE) and the Medical Research Council (MRC). The Science Policy Research Unit (SPRU) at the University of Sussex is administering the survey. The primary purpose of the survey is to provide an understanding of perceived barriers to and incentives for interdisciplinary research and how these influence the types of research activities in your institution. The survey has been designed for strategic leaders in Higher Education organisations based in the UK. Participation in this survey is voluntary. Please find here a letter of support from HEFCE and MRC, encouraging strategic leaders' participation. All responses will be anonymised (please avoid including references that identify yourself or others in the free text responses). The findings of the survey will be reported publicly and used to inform policy debate. Further information on the survey, data use and protection is available as Additional Information about the Survey for Strategic Leaders. Before you decide to participate, please confirm that you have been adequately informed about the survey and agree with the following statements: I confirm that I have read and understand the information above. I understand that my anonymous response will be used for research and to inform policy debate. I consent to the use of my anonymous response for the above purposes.

- ☐ Agree
- ☐ Disagree

What types of research does the term interdisciplinary include? In this survey, we use the term interdisciplinary research to refer to all research activities that cross disciplinary boundaries (in contrast to monodisciplinary research). These include research activities that are often described as multidisciplinary, transdisciplinary, and crossdisciplinary as well as interdisciplinary.

To what extent do you consider interdisciplinary research important for your institution?

- ☐ Extremely important
- ☐ Very important
- ☐ Moderately important
- ☐ Slightly important
- ☐ Not at all important
- ☐ I do not know

Please indicate which management role you cover in your institution? (multiple options can be selected)

- ☐ Head* of Faculty
- ☐ Head* of School
- ☐ Head* of Department
- ☐ Deputy Director** of Faculty
- ☐ Deputy Director** of School
- ☐ Deputy Director** of Department
- ☐ Head* of Institute
- ☐ Head* of Research Centre
- ☐ Head* of Academic Unit (or Research Group)
- ☐ Head* of Programme
- ☐ Head* of Research of Faculty
- ☐ Head* of Research of School
- ☐ Head* of Research of Department
- ☐ Head* of Teaching of Faculty
- ☐ Head* of Teaching of School
- ☐ Head* of Teaching of Department
- ☐ Head* of Doctoral Studies of Faculty
- ☐ Head* of Doctoral Studies of School

- ☐ Head* of Doctoral Studies of Department
- ☐ Head* of a Unit of Assessment (REF2014)
- ☐ Head* of a Unit of Assessment (next REF)
- ☐ Head* of Research Support Services
- ☐ Research Coordinator
- ☐ Pro-Vice Chancellor
- ☐ Vice Chancellor
- ☐ Other roles (please specify below) _____

*or Dean, Director, Lead, or similar**or Associate Dean, Associate Head, Co-Director, Co-Lead, or similar

Which subject area does your management role focus on? (multiple options can be selected)

- ☐ Agriculture and forestry
- ☐ Arts, humanities and social sciences
- ☐ Modern foreign languages
- ☐ Science, Technology, Engineering and Mathematics
- ☐ Clinical subjects
- ☐ No specific focus
- ☐ Other _____

Is interdisciplinary research a priority for your institution?

- ☐ Yes
- ☐ No
- ☐ Prefer not to say
- ☐ I do not know

To what extent do the following factors make interdisciplinary research a priority for your institution?

| | Not at all influential | Slightly influential | Moderately influential | Very influential | Extremely influential | I do not know |
|--------------------|------------------------|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|
| Access to research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

funding
within the UK

Access to
research
funding
outside the
UK

Access to
research
funding from
industry

Collaboration
with other
academic
institutions

Collaboration
with non-
academic
organisations

Expected
academic
impact

Expected
impact
beyond
academia

Complexity
of research
problems

| | | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

In your opinion, the support for interdisciplinary research in your institution is ...

- ☐ Strongly established
- ☐ Somewhat established
- ☐ Just developing
- ☐ Unavailable
- ☐ Prefer not to say
- ☐ I do not know

Which measures does your institution actively employ to support interdisciplinary research? (multiple options can be selected)

- ☐ Interdisciplinary training for researchers
- ☐ Interdisciplinary training for students
- ☐ Recruitment of interdisciplinary researchers
- ☐ Internal research funding
- ☐ Developing research networks with other Higher Education institutions
- ☐ Developing research networks with non-academic organisations
- ☐ Developing internal research networks
- ☐ Recognising interdisciplinary research in reward and progression policies
- ☐ Dedicated interdisciplinary research centres/institutes
- ☐ Dedicated collaboration spaces
- ☐ Initiatives and funding to uptake findings from interdisciplinary research
- ☐ Preparing for external research evaluation
- ☐ Other (please specify below) _____

How successful is your institution at supporting interdisciplinary research through the following measures?

In your management role, have been you involved in any of the following measures for supporting interdisciplinary research?

In your opinion, to what extent do the following factors influence researchers in your institution when considering whether to undertake interdisciplinary research?

| | Not at all influential | Slightly influential | Moderately influential | Very influential | Extremely influential | I do not know |
|--|------------------------|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|
| Concerns over career progression | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Difficulties in obtaining external funding | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| A lack of external funding | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

opportunities

Challenges in working with collaborators

☐ ☐ ☐ ☐ ☐ ☐

C.10.1 Interdisciplinary research and career

On the basis of your experience in your current institution, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Promotion and tenure policies discourage interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research often provides better job opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Considerable time for additional training is required for researchers to undertake interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| A strong disciplinary training of researchers is an essential foundation for interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Peers in researchers' core discipline(s) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

often consider
interdisciplinary
research as
less rigorous

If you have any comments on the above statements please report these below.

C.10.2 Interdisciplinary research and funding

In your opinion, is interdisciplinary research more or less likely to be funded than monodisciplinary research in the UK?

- ☐ Less likely
- ☐ Equally likely
- ☐ More likely
- ☐ I do not know

On the basis of your experience in your current institution, please indicate the extent to which the following factors make interdisciplinary research less likely to be funded than monodisciplinary research.

| | Not at all influential | Slightly influential | Somewhat influential | Very influential | Extremely influential | I do not know |
|--|---------------------------|-------------------------|-------------------------|-----------------------|--------------------------|-----------------------|
| Monodisciplinary perspective of reviewers | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research may be considered more risky | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research may be considered of a lower quality | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Difficulties in producing strong research proposals | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Disciplinary focus of funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on factors that may affect the likelihood of obtaining funding for interdisciplinary research, please report these below.

On the basis of your experience in your current institution, please indicate the extent to which the following factors make interdisciplinary research more likely to be funded than monodisciplinary research.

| | Not at all influential | Slightly influential | Somewhat influential | Very influential | Extremely influential | I do not know |
|--|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Increasing focus of Funders on supporting interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Lower competition because of the lower number of research project proposals that are submitted | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Expectations of higher impact from interdisciplinary research projects | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Access to larger funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on factors that may affect the likelihood of obtaining funding for interdisciplinary research, please report these below.

C.10.3 Interdisciplinary research and collaboration

On the basis of your experience in your current institution, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|--|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Interdisciplinary research provides researchers with more learning opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

through
interaction with
experts in other
disciplines

It is more
difficult for
researchers to
identify partners
for
interdisciplinary
research

Communication
among
researchers is
more difficult in
interdisciplinary
teams

Interdisciplinary
research
requires co-
location of
researchers
more than
monodisciplinary
research

Interdisciplinary
research is more
likely to involve
non-academic
partners

Supporting
interdisciplinary
research is more
complex than
supporting
monodisciplinary
research

Interdisciplinary
research
requires more
investment of
institutional
resources than
monodisciplinary
research

☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐

If you have any comments on the above statements please report these below.

C.10.4 *Interdisciplinary research and outcomes*

On the basis of your experience in your current institution, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Interdisciplinary research is less likely to be published in top-tier monodisciplinary journals | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to be published in journals with broader audiences | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to become highly cited | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Research evaluation (e.g. REF) encourages interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Research evaluation (e.g. REF) undervalues interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to generate societal impact | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

likely to open
new research
fields

Interdisciplinary
research
requires more
time to produce
outcomes

Interdisciplinary
research
outcomes are
more likely to
meet institution
research
priorities

☐ ☐ ☐ ☐ ☐ ☐

☐ ☐ ☐ ☐ ☐ ☐

If you have any comments on the above statements please report these below.

Are you a researcher?

- ☐ Yes
- ☐ No
- ☐ Prefer not to say

What is your job title?

- ☐ Professor
- ☐ Emeritus Professor
- ☐ Reader
- ☐ Emeritus Reader
- ☐ Associate Professor
- ☐ Senior Lecturer/Principal Lecturer
- ☐ Lecturer
- ☐ Assistant Professor
- ☐ Senior Research Fellow
- ☐ Research Fellow
- ☐ Senior Teaching Fellow
- ☐ Teaching Fellow

- ☐ Postdoc
- ☐ Research Associate
- ☐ Other academic position _____

Your position is ...

- ☐ full-time (open-ended/permanent)
- ☐ full-time (fixed-term)
- ☐ part-time (open-ended/permanent)
- ☐ part-time (fixed-term)

Please indicate the percentage of your part-time position.

_____ % Full-time equivalent (FTE)

What percentage of time is allocated to your own research?

_____ Percentage (%)

Please indicate the areas in which you have completed training. (multiple options can be selected)

| | Agriculture and forestry | Arts, humanities and social sciences | Modern foreign languages | Science, Technology, Engineering and Mathematics | Clinical subjects | Other |
|--|--------------------------------|---|--------------------------------|--|--------------------------|--------------------------|
| Undergraduate degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Postgraduate degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Doctoral level degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other qualifications (please specify below) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

C.10.5 Demographic data

What is your age?

- ☐ Below 30

- ☐ 30 to 39
- ☐ 40 to 49
- ☐ 50 to 59
- ☐ 60 and over
- ☐ Prefer not to say

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

What is your nationality?

Please mention further nationalities if applicable.

Do you have any other comment or recommendation on the topic of the survey?

C.11 FOR FUNDERS

Dear Research Manager, You are invited to take part in a short on-line survey (of 10-15 minutes) on "Barriers to and incentives for interdisciplinary research in the UK". This survey has been commissioned by the Higher Education Funding Council for England (HEFCE) and the Medical Research Council (MRC). The Science Policy Research Unit (SPRU) at the University of Sussex is administering the survey. The primary purpose of the survey is to provide an understanding of perceived barriers to and incentives for interdisciplinary research and how these influence research funding and the types of research activities. The survey has been designed for staff that manage the allocation of research funding in the UK. Participation in this survey is voluntary. Please find here a letter of support from HEFCE and MRC (representing the UK research councils), encouraging your participation. All responses will be anonymised (please avoid including references that identify yourself or others in the free text responses). The findings of the survey will be reported publicly and used to inform policy debate. Further information on the survey, data use and protection is available as Additional Information about the Survey for UK Funders. Before you decide to participate, please confirm that you have been adequately informed about the survey and agree with the following statements: I confirm that I have read and understand the information above. I understand that my anonymous response will be used for research and to inform policy debate. I consent to the use of my anonymous response for the above purposes.

- ☐ Agree
- ☐ Disagree
- ☐ My organisation's primary focus is not to support research
- ☐ My organisation is not based in the United Kingdom

What types of research does the term interdisciplinary include? In this survey, we use the term interdisciplinary research to refer to all research activities that cross disciplinary boundaries (in contrast to monodisciplinary research). These include research activities that are often described as multidisciplinary, transdisciplinary, and crossdisciplinary as well as interdisciplinary.

To what extent do you consider supporting interdisciplinary research important?

- ☐ Extremely important
- ☐ Very important
- ☐ Moderately important
- ☐ Slightly important
- ☐ Not at all important
- ☐ I do not know

Please indicate which of the following describe your organisation. (multiple options can be selected)

- ☐ Government department
- ☐ Charity/Trust/Foundation
- ☐ Professional Association
- ☐ Other (please specify below) _____

What budget does your organisation allocate, on an annual basis, to support research?

- ☐ Less than £50,000
- ☐ More than £50,000, but less than £250,000
- ☐ More than £250,000, but less than £1 Million
- ☐ More than £1 Million, but less than £10 Million
- ☐ More than £10 Million, but less than £100 Million
- ☐ More than £100 Million, but less than £250 Million
- ☐ More than £250 Million
- ☐ Prefer not to say
- ☐ I do not know

In which part of the UK is your organisation based?

- ☐ Bedfordshire and Hertfordshire
- ☐ Berkshire, Buckinghamshire and Oxfordshire
- ☐ Cheshire
- ☐ Cornwall and Isles of Scilly
- ☐ Cumbria

- Derbyshire and Nottinghamshire
- Devon
- Dorset and Somerset
- East Anglia
- East Wales
- East Yorkshire and Northern Lincolnshire
- Eastern Scotland
- Essex
- Gloucestershire, Wiltshire and Bristol/Bath area
- Greater Manchester
- Hampshire and Isle of Wight
- Herefordshire, Worcestershire and Warwickshire
- Highlands and Islands
- Inner London
- Kent
- Lancashire
- Leicestershire, Rutland and Northamptonshire
- Lincolnshire
- Merseyside
- North Eastern Scotland
- North Yorkshire
- Northern Ireland
- Northumberland and Tyne and Wear
- Outer London
- Shropshire and Staffordshire
- South Western Scotland
- South Yorkshire
- Surrey, East and West Sussex
- Tees Valley and Durham
- West Midlands
- West Wales and The Valleys
- West Yorkshire

Please indicate which role you cover in your organisation? (multiple options can be selected)

- ☐ Head of Organisation/Chief Executive
- ☐ Director of Research
- ☐ Associate Director
- ☐ Strategy and Development Manager
- ☐ Team Head
- ☐ Senior Programme Lead
- ☐ Programme Lead
- ☐ Senior Programme Manager
- ☐ Programme Manager
- ☐ Senior Programme Officer
- ☐ Programme Officer
- ☐ Senior Portfolio Manager
- ☐ Portfolio Manager
- ☐ Prefer not to say
- ☐ Other _____

Which subject area does your role focus on? (multiple options can be selected)

- ☐ Agriculture and forestry
- ☐ Arts, humanities and social sciences
- ☐ Modern foreign languages
- ☐ Science, Technology, Engineering and Mathematics
- ☐ Clinical subjects
- ☐ No specific focus
- ☐ Other _____

In your opinion, is supporting interdisciplinary research a priority for your organisation?

- ☐ Yes
- ☐ No
- ☐ Prefer not to say
- ☐ I do not know

In your opinion, the support for interdisciplinary research by your organisation is ...

- ☐ Strongly established

- ☐ Somewhat established
- ☐ Just developing
- ☐ Unavailable
- ☐ Prefer not to say
- ☐ I do not know

Through which funding mechanisms does your organisation support research? (multiple options can be selected)

- ☐ Studentships
- ☐ Fellowships
- ☐ Infrastructure/facilities funding
- ☐ Funding of research centres
- ☐ Research project grants
- ☐ Joint-funding initiatives with other organisations
- ☐ Research meetings
- ☐ Travel
- ☐ Teaching buy-out
- ☐ Other (please specify below) _____

How does your organisation allocate research funding? (multiple options can be selected)

Please indicate which (if any) of the following award based funding* your organisation employs to support interdisciplinary research. (multiple options can be selected)

*Award based funding: grant funding to address a specific research objective in relation to a predetermined research question. The funding is often accessed through a competitive applications process but also includes discretionary awards. This excludes commercial contracts. Grants can come from the public, private or charitable sectors.

Please indicate which (if any) of the following block grant funding employs to support interdisciplinary research. (multiple options can be selected)**

**Block grant funding: grant funding which supports general research activity either across all areas of research or in a particular area of interest but not a predetermined research question. Funding may come from the public, private or charitable sectors and is not allocated through a competitive applications process.

In your opinion, to what extent do the following factors influence researchers when considering whether to undertake interdisciplinary research?

| | Not at all influential | Slightly influential | Moderately influential | Very influential | Extremely influential | I do not know |
|--|------------------------|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|
| Concerns over career progression | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Difficulties in obtaining external funding | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| A lack of external funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Challenges in working with collaborators | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

C.11.1 *Interdisciplinary research and career*

On the basis of your experience in the UK, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Promotion and tenure policies in higher education organisations discourage interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research often provides researchers with better job opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Considerable time for additional training is | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

required for
researchers to
undertake
interdisciplinary
research

A strong
disciplinary
training of
researchers is
an essential
foundation for
interdisciplinary
research

Peers in
researchers'
core
discipline(s)
often consider
interdisciplinary
research as
less rigorous

| | | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on the above statements please report these below.

C.11.2 Interdisciplinary research and funding

In your opinion, is interdisciplinary research more or less likely to be funded than monodisciplinary research in the UK?

- ☐ Less likely
- ☐ Equally likely
- ☐ More likely
- ☐ I do not know

On the basis of your experience in the UK, please indicate the extent to which the following factors make interdisciplinary research less likely to be funded than monodisciplinary research.

| | Not at all influential | Slightly influential | Somewhat influential | Very influential | Extremely influential | I do not know |
|--|---------------------------|-------------------------|-------------------------|-----------------------|--------------------------|-----------------------|
| Monodisciplinary perspective of reviewers | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research may be considered more risky | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research may be | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

considered of a lower quality

| | | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Difficulties in producing strong research proposals | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Disciplinary focus of funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Finding reviewers with appropriate breadth of knowledge | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research may not be considered central to Funders' remit | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research projects tend to be more expensive | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on factors that may affect the likelihood of obtaining funding for interdisciplinary research, please report these below.

On the basis of your experience in the UK, please indicate the extent to which the following factors make interdisciplinary research more likely to be funded than monodisciplinary research.

| | Not at all influential | Slightly influential | Somewhat influential | Very influential | Extremely influential | I do not know |
|--|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Increasing focus of Funders on supporting interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Lower competition because of the lower number of research project proposals that are submitted | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Expectations of higher impact from interdisciplinary research projects | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Access to larger funding opportunities | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on factors that may affect the likelihood of obtaining funding for interdisciplinary research, please report these below.

C.11.3 Interdisciplinary research and collaboration

On the basis of your experience in the UK, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|--|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Interdisciplinary research provides researchers with more learning opportunities through interaction with experts in other disciplines | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| It is more difficult for researchers to identify partners for interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Communication among researchers is more difficult in interdisciplinary teams | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research requires co-location of researchers | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

more than
monodisciplinary
research

Interdisciplinary research is more likely to involve non-academic partners

Supporting interdisciplinary research is more complex than supporting monodisciplinary research

Interdisciplinary requires more investment of institutional resources than monodisciplinary research

If you have any comments on the above statements please report these below.

C.11.4 *Interdisciplinary research and outcomes*

On the basis of your experience in the UK, please indicate the extent to which you agree/disagree with the following statements on interdisciplinary research (compared with monodisciplinary research).

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly Agree | I do not know |
|---|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|-----------------------|
| Interdisciplinary research is less likely to be published in top-tier monodisciplinary journals | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to be published in journals with broader audiences | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

likely to become highly cited

| | | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Research evaluation (e.g. REF) encourages interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Research evaluation (e.g. REF) undervalues interdisciplinary research | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to generate societal impact | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research is more likely to open new research fields | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Interdisciplinary research requires more time to produce outcomes | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

If you have any comments on the above statements please report these below.

Please indicate the areas in which you have completed training. (multiple options can be selected)

| | Agriculture and forestry | Arts, humanities and social sciences | Modern foreign languages | Science, Technology, Engineering and Mathematics | Clinical subjects | Other |
|-----------------------|--------------------------|--------------------------------------|--------------------------|--|--------------------------|--------------------------|
| Undergraduate degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Postgraduate degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Doctoral level degree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other qualifications | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

(please specify
below)

C.11.5 Demographic data

What is your age?

- ☐ Below 30
- ☐ 30 to 39
- ☐ 40 to 49
- ☐ 50 to 59
- ☐ 60 and over
- ☐ Prefer not to say

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

What is your nationality?

Do you have any other comment or recommendation on the topic of the survey?

technopolis **[group]** United Kingdom
3 Pavilion Buildings
Brighton BN1 1EE
United Kingdom
T +44 1273 204320
E info@technopolis-group.com
www.technopolis-group.com